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simulating the management of even-aged timber stands

by Clifford A. Myers

Rocky Mountain Forest and Range Experiment Station
U.S. Department of Agriculture
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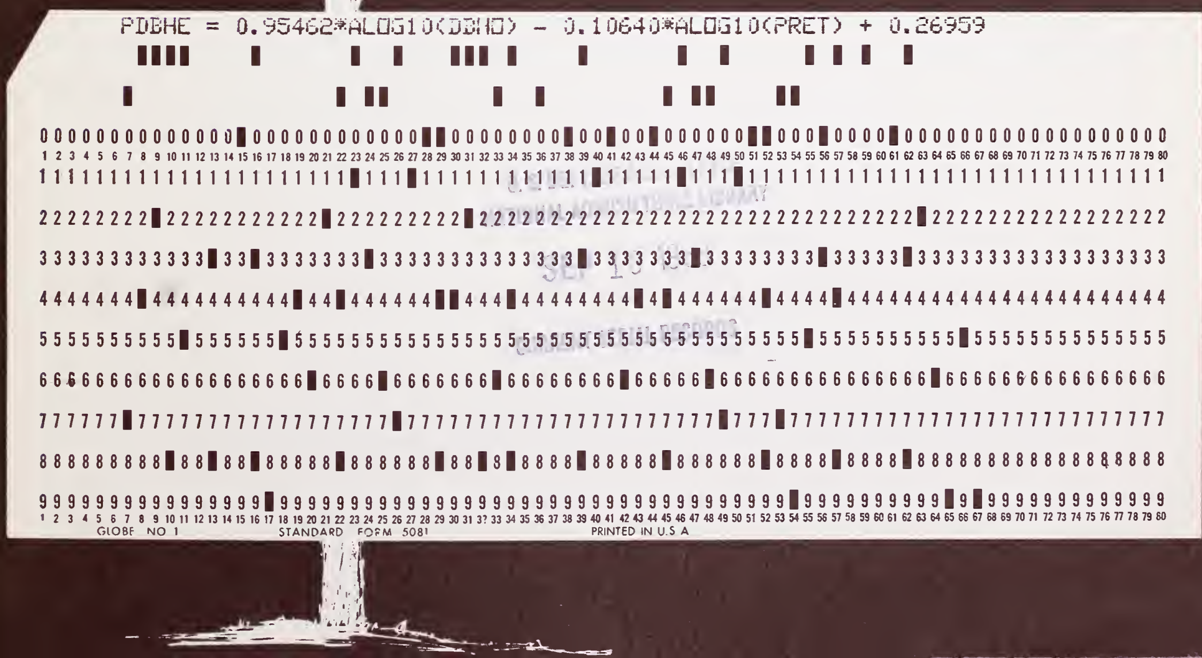

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Simulating the Management of Even-Aged Timber Stands

By

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[1]Central headquarters maintained at Fort Collins in cooperation with Colorado State University.

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Simulating the Management of Even-Aged Timber Stands

Clifford A. Myers

Introduction

Good decisions that lead to efficient, low-cost operations are as necessary for timber management as for any other business activity. Gathering of information on which to base such decisions is unusually difficult because of the peculiar characteristics of the business of growing wood. The time needed to mature a crop is long, and, with many tree species, results of changes appear slowly. Decisions must be made for large areas of land and for numerous possible combinations of biological and economic conditions. A procedure whereby a manager can examine quickly the probably outcomes of many variations in management should be of value. Such a procedure appears especially useful when the computation time required is about 10 seconds for each combination of possible alternatives examined. This approach to managerial decisionmaking is made possible by electronic computers and the technique of simulation.

Simulation involves the creation and operation of a model that is similar in relationships to the natural system studied. The system may be a factory, a forest, or any one of countless other subjects of interest. Mathematical simulation, where the model is a set of equations, is a powerful tool of management and investigation. Mathematical models are used to discover new facts and to test alternatives. Time can be compressed so a sequence of events can be studied in a fraction of the time required for operation of the natural system, thereby permitting projections into the future(Chorafas 1965).

Manipulation of a model by simulation is especially useful where: (1) the actual system should not be changed until decisions have been made; (2) possible changes are numerous and are costly in money, effort, and time; and (3) exact data cannot be obtained because of cost or complexity of the relationships involved (Churchman et al. 1957, Dane 1966).

Several authors have presented the principles of simulation to foresters, and have shown how forestry simulators may be constructed. These authors have discussed the development of models (Chappelle 1966) and the systems approach to forestry problems (O'Regan et al. 1966). Others have described simulators of timber production activities, and presented information obtained from their operation (Clutter and Bamping 1966, Gould and O'Regan 1965). Thompson's (1966) discussion of the need for tests of alternatives in forest regulation points out a value of simulation for research. Validity of many long-accepted concepts of timber management can be tested quickly, cheaply, and for a wide variety of conditions.

Gould and O'Regan (1965) performed a special service to timber managers by publishing a simulator at a time when examples were relatively inaccessible to most foresters. Their computer program will long serve as a source of ideas and procedures; it has so served for the program presented here.

Program MANAGD (appendix 1) is a means for simulation of the management of even-aged stands for roundwood and saw logs. It contains provisions for stand growth, thinnings, harvest cuts, planting of nonstocked areas, and other changes in forest conditions. Inputs to the program permit wide choice in the management alternatives and stand conditions to be examined. Possible options and alternatives are presented in the appropriate sections of the program description.

The program was written in A.S.A. Fortran IV (X3.9-1966) and tested on a CDC 6400 computer.[2] Program organization will permit ready modification to fit local tree species and computing equipment. Once the program is in use, improved or additional data and procedures can be inserted easily, as they become available.

[1] *Trade names and company names are used for the benefit of the reader, and do not imply endorsement or preferential treatment by the U. S. Department of Agriculture.*

Description of Program MANAGD

Program MANAGD consists of a main program and 11 subroutine subprograms (appendix 1). Content and purpose of each routine are given in the sections that follow. Definitions of variable names are listed with the source program in appendix 1 and in the listing of contents of the data deck. The test problem described on page 14 and reported in appendix 2 provides additional explanation of the program.

The terms **batch**, **test**, and **game** are used to identify individual simulations performed with various groupings of alternatives. The **BATCH** name identifies the entire group of tests and games to be completed as a single job by a computer. A test consists of one or more games, all of which are based on a single yield table and one set of stumpage prices. **Games** of a test differ from one another in distribution of acres by age classes, area planted, and limitations on the annual cut.

Main Program

The main program calls 10 subroutines in proper sequence, and uses counter IJK to call an eleventh subroutine (OUTPUT1) at specified intervals. The first four subroutines called read the data deck, compute and print a yield table, and compute and print potential volumes per acre at each year of stand age. A fifth subroutine generates a working circle with the specified number of acres in each age class. Subroutines YEARS and ANUAL are the dynamic components of the program. They provide for stand growth, thinnings, harvests, losses, and other changes in volume and value. Four subroutines produce a record of results. Numbers of acres in each age class are printed at the end of the first year of a game and at the end of each decade. Volume and dollar values are printed at the end of each game. An optional subroutine (SUMRY) prints selected values from several games of a test together to simplify comparisons.

The main program enters BATCH name and the number of tests in a batch into computer memory.

Subroutine INPUT1

INPUT1 is called once each test to read values that apply to all games of a test. Values entered include stumpage prices, minimum commercial volumes, and items used to compute a yield table. Controls on the program are entered as number of games in a test, number of years in a game, and number of columns of OUTPUT2 to be summarized by SUMRY.

Values read by subroutine INPUT1 are printed as part of the output of other subroutines.

Subroutine YIELD

Subroutine YIELD reads four tables and computes and prints yield tables for managed, even-aged stands. It is called once each test to produce the yield table that will apply to all games of the test. Values in each yield table reflect prior decisions on the frequency and intensity (table 1) of intermediate cuttings.

Computations performed by the subroutine follow procedures described in detail elsewhere (Myers 1966, Myers and Godsey 1968). Average stand diameter (d.b.h.) and number of trees per acre just before initial thinning are estimated from measurements of stands of suitable ages and densities. Number of trees and d.b.h. are used to compute initial and subsequent basal areas per acre. Total cubic volumes per acre are computed from basal area, d.b.h., and tree height (table 2) by means of a stand volume equation (statements for TOTO and TOTT). Total cubic volumes are multiplied by factors to convert them to merchantable cubic volumes (table 3) and board feet (table 4).

Increase in d.b.h. due to initial thinning is computed by the iterative process of FORTRAN statements 6 to 12, inclusive. The equation for PDBHE provides an estimate of diameter after thinning when diameter before thinning and the percentage of trees retained are known (Myers 1966). Successive percentages are tested until d.b.h. after thinning, number of trees, and basal area agree with the desired thinning intensity entered as THIN by INPUT1 and as defined in table 1. Equations for DBHP, such as statement 7, express that part of table 1 where basal area is less than 66.3 square feet.

Table 1 gives residual basal area after thinning for various average stand diameters. The values represent one possible series of densities that could be used to guide successive thinnings in a stand. The series is labeled growing stock level 80 to indicate that reserve basal area is 80 square feet per acre when d.b.h. after cutting

Table 1.--Basal areas after intermediate cutting in relation to average stand diameter
Growing stock level 80 for Black Hills ponderosa pine

Average stand d.b.h. after cutting (Inches)	Basal area per acre	Average stand d.b.h. after cutting (Inches)	Basal area per acre	Average stand d.b.h. after cutting (Inches)	Basal area per acre	Average stand d.b.h. after cutting (Inches)	Basal area per acre
	Sq. ft.		Sq. ft.		Sq. ft.		Sq. ft.
2.0	12.3	4.0	35.2	6.0	56.6	8.0	72.5
2.1	13.3	4.1	36.4	6.1	57.6	8.1	73.2
2.2	14.4	4.2	37.6	6.2	58.5	8.2	73.8
2.3	15.5	4.3	38.7	6.3	59.4	8.3	74.4
2.4	16.6	4.4	39.8	6.4	60.3	8.4	74.9
2.5	17.7	4.5	41.0	6.5	61.1	8.5	75.4
2.6	18.9	4.6	42.2	6.6	62.0	8.6	75.8
2.7	20.1	4.7	43.4	6.7	62.9	8.7	76.3
2.8	21.3	4.8	44.6	6.8	63.8	8.8	76.7
2.9	22.5	4.9	45.7	6.9	64.7	8.9	77.1
3.0	23.6	5.0	46.7	7.0	65.5	9.0	77.5
3.1	24.8	5.1	47.7	7.1	66.2	9.1	77.9
3.2	26.0	5.2	48.8	7.2	67.0	9.2	78.2
3.3	27.2	5.3	49.9	7.3	67.7	9.3	78.5
3.4	28.4	5.4	50.9	7.4	68.4	9.4	78.8
3.5	29.6	5.5	51.8	7.5	69.1	9.5	79.0
3.6	30.7	5.6	52.8	7.6	69.8	9.6	79.2
3.7	31.8	5.7	53.7	7.7	70.5	9.7	79.5
3.8	32.9	5.8	54.7	7.8	71.2	9.8	79.7
3.9	34.1	5.9	55.6	7.9	71.9	9.9	79.9
						10.0+	80.0

Table 2.--Average height of dominant and codominant trees at various ages, Black Hills ponderosa pine

Main stand age (Years)	Site index class			
	40	50	60	70
	- - - - - Feet - - - - -			
10	4.5	4.5	4.5	4.5
20	9	10	12	16
30	11	16	20	26
40	17	22	28	35
50	21	28	35	43
60	26	33	41	50
70	30	38	47	56
80	34	43	52	61
90	37	47	57	66
100	40	50	60	70
110	43	53	63	74
120	45	56	66	77
130	46	59	69	80
140	48	61	71	83
150	50	63	73	86
160	51	64	75	88
170	52	65	77	90
180	53	66	78	91

Table 3.--Factors for conversion of stand volumes in total cubic feet to merchantable cubic feet per acre,[1] Black Hills ponderosa pine

Average stand diameter (Inches)	Ratio of merchantable to total volume	Average stand diameter (Inches)	Ratio of merchantable to total volume	Average stand diameter (Inches)	Ratio of merchantable to total volume
5.0	0.332	8.1	0.849	11.9	0.940
5.1	.355	8.2	.856	12.1	.941
5.2	.377	8.3	.862	12.4	.942
5.3	.400	8.4	.868	12.7	.943
5.4	.422	8.5	.872	12.9	.944
5.5	.444	8.6	.876	13.1	.945
5.6	.465	8.7	.880	13.3	.946
5.7	.487	8.8	.884	13.5	.947
5.8	.508	8.9	.888	13.7	.948
5.9	.530	9.0	.892	13.9	.949
6.0	.552	9.1	.896	14.2	.950
6.1	.575	9.2	.899	14.4	.951
6.2	.597	9.3	.902	14.7	.952
6.3	.618	9.4	.906	14.9	.953
6.4	.639	9.5	.910	15.2	.954
6.5	.659	9.6	.913	15.4	.955
6.6	.678	9.7	.916	15.8	.956
6.7	.694	9.8	.920	16.3	.957
6.8	.710	9.9	.923	16.8	.958
6.9	.725	10.0	.926	17.3	.959
7.0	.740	10.1	.928	17.8	.960
7.1	.753	10.2	.930	18.3	.961
7.2	.766	10.3	.931	18.8	.962
7.3	.778	10.4	.932	19.3	.963
7.4	.789	10.5	.933	19.8	.964
7.5	.799	10.7	.934	20.3	.965
7.6	.809	10.9	.935	20.9	.966
7.7	.818	11.1	.936	21.7	.967
7.8	.826	11.3	.937	22.5	.968
7.9	.834	11.5	.938	23.3	.969
8.0	.842	11.7	.939	23.9	.969

[1] To 4.0-inch top in trees 6.0 inches d.b.h. and larger.

Factor for an unlisted diameter equals factor for next smaller listed diameter. For example, factor for 15.6 inches is .955.

Table 4.--Factors for conversion of stand volumes in total cubic feet to board feet Scribner rule per acre,[1] Black Hills ponderosa pine

Average stand diameter (Inches)	Ratio of board feet to cubic feet	Average stand diameter (Inches)	Ratio of board feet to cubic feet	Average stand diameter (Inches)	Ratio of board feet to cubic feet	Average stand diameter (Inches)	Ratio of board feet to cubic feet
8.0	0.78	11.9	3.49	15.8	4.71	19.7	5.42
8.1	.85	12.0	3.56	15.9	4.73	19.8	5.44
8.2	.92	12.1	3.61	16.0	4.76	19.9	5.45
8.3	.99	12.2	3.65	16.1	4.78	20.0	5.46
8.4	1.06	12.3	3.69	16.2	4.81	20.1	5.47
8.5	1.13	12.4	3.73	16.3	4.83	20.2	5.48
8.6	1.20	12.5	3.77	16.4	4.86	20.3	5.50
8.7	1.27	12.6	3.80	16.5	4.88	20.4	5.51
8.8	1.34	12.7	3.84	16.6	4.90	20.5	5.52
8.9	1.41	12.8	3.88	16.7	4.92	20.6	5.53
9.0	1.48	12.9	3.91	16.8	4.94	20.7	5.54
9.1	1.55	13.0	3.95	16.9	4.96	20.8	5.56
9.2	1.62	13.1	3.98	17.0	4.98	20.9	5.57
9.3	1.68	13.2	4.02	17.1	5.00	21.0	5.58
9.4	1.75	13.3	4.05	17.2	5.02	21.1	5.59
9.5	1.82	13.4	4.08	17.3	5.04	21.2	5.60
9.6	1.89	13.5	4.11	17.4	5.06	21.3	5.61
9.7	1.96	13.6	4.14	17.5	5.08	21.4	5.62
9.8	2.03	13.7	4.17	17.6	5.10	21.5	5.63
9.9	2.10	13.8	4.20	17.7	5.12	21.6	5.64
10.0	2.17	13.9	4.23	17.8	5.13	21.7	5.65
10.1	2.24	14.0	4.25	17.9	5.15	21.8	5.66
10.2	2.31	14.1	4.28	18.0	5.17	21.9	5.67
10.3	2.38	14.2	4.31	18.1	5.19	22.0	5.68
10.4	2.45	14.3	4.34	18.2	5.21	22.1	5.69
10.5	2.52	14.4	4.37	18.3	5.22	22.2	5.70
10.6	2.59	14.5	4.39	18.4	5.24	22.3	5.71
10.7	2.65	14.6	4.42	18.5	5.26	22.4	5.72
10.8	2.72	14.7	4.44	18.6	5.27	22.5	5.73
10.9	2.79	14.8	4.47	18.7	5.29	22.6	5.74
11.0	2.86	14.9	4.49	18.8	5.30	22.7	5.75
11.1	2.93	15.0	4.52	18.9	5.32	22.8	5.76
11.2	3.00	15.1	4.54	19.0	5.33	22.9	5.77
11.3	3.07	15.2	4.56	19.1	5.35	23.0	5.78
11.4	3.14	15.3	4.58	19.2	5.36	23.1	5.79
11.5	3.21	15.4	4.61	19.3	5.37	23.2	5.80
11.6	3.28	15.5	4.64	19.4	5.39	23.3	5.81
11.7	3.35	15.6	4.66	19.5	5.40	23.4	5.82
11.8	3.42	15.7	4.68	19.6	5.41	23.5	5.83

[1] To 8-inch top in trees 10.0 inches d.b.h. and larger.

is 10 inches or larger. Other stocking levels are named the same way. For example, stocking level 100 means that reserve basal area will be 100 square feet when d.b.h. after cutting is 10 inches or larger. Basal areas for level 100 and for diameters smaller than 10 inches are obtained by multiplying each basal area of level 80 by the amount 100/80. Values for other stocking levels, perhaps from 50 to 160, are computed similarly.

Periodic increases in d.b.h. due to tree growth are estimated by the equation for DBHO in the loop headed DO 23. The equation used in the example is for Black Hills ponderosa pine, and for a projection period of 10 years. Equations for other species or projection periods may be inserted as desired. Intervals between intermediate cuttings are one or more projection periods long.

It is often desirable to make simulations more realistic through introduction of variability in values estimated by equations or contained in tabulations. For example, repeated computations of DBHO without change in values of the independent variables will always give the same numerical result. In reality, actual and estimated values frequently differ. A way of providing variability in estimates of DBHO is contained in the program segment between statements 100 and 110. Similar statements could be written for other variables.

Variability is obtained in three steps; (1) generation of a pseudorandom number, (2) use of this number as an independent variable to compute the value of a residual (range: -0.3 to +0.3 inch), and (3) addition of the residual to the computed value of DBHO. The pseudorandom number generator, statement 100, is of the form:

$$X_i \equiv AX_{i-1} + C \text{ (modulo M)}$$

(Greenberger 1961). Values of all elements of the generator are specified except for X_{i-1}, which is read in as variable GNTR. The statement to compute RES is an empirical distribution function obtained by fitting a polynomial to the normally distributed residuals of the DBHO equation (Evans et al. 1967). An approximation to the normal distribution function may also be used (Burr 1967).

Rethinnings increase d.b.h. an average of 0.4 inch when stand densities approximate growing stock levels most likely to be goals of timber management.

The program can be adapted readily for simulations with species other than the one used for the test problem. Replacement of tables 1 to 4, several statements of YIELD, and species designations in two table headings are all the substitutions necessary if the same projection procedure is used. Statements to be replaced are the equations for TOTO, TOTT, DBHP, PDBHE, and DBHO. Projections based on other procedures, such as direct estimation of volume, can be written as a new subroutine YIELD. It is necessary only to transfer values of CFMO(I), BDFO(I), CFMC(I), and BDFC(I) to the next subroutine, and to make appropriate changes in the READ statements in INPUT1.

Subroutine ANVOL

Subroutine ANVOL is called once each test to compute volume per acre for each year from initial thinning to maximum stand age. Volumes in cubic feet and board feet are computed by linear interpolation and printed in a composite table. Stand ages cannot exceed 179 years unless dimensions of the 180-location arrays of acres and annual volumes are increased.

The last few statements of the routine expand the array of volumes cut to assign the volume of each intermediate cut to each of the years before the next cut is made. These amounts are added to potential postthinning volumes in subroutine YEARS to compute volumes per acre of any stands not given intermediate cutting because they are older than minimum age for harvest.

Subroutine INPUT2

INPUT2 is called once each game to enter numerical values of variables that may differ for each game of a test. Descriptive data include area of the working circle, distribution of area by age classes, nonstocked area, and number of acres to be planted annually. Various costs and the rate at which they change from year to year are entered into computer memory. One to ten combinations of price limit, allowable cut, and minimum cutting age are read in for the determination of annual cut described in the section on the data deck.

Values read by INPUT2 that do not appear in other tables are printed as a record of game conditions on pages headed "alternatives for this game."

Subroutine AREAS

AREAS is called once each game to compute volumes and area distributions at the end of the year before simulation begins. Acres in each 1-year age class are expanded to obtain a record of the age of each individual acre. Total area (LAND) cannot exceed 1,000 acres unless the dimension of ACAGE(I) is increased. Age of the oldest acre cannot exceed 179 years unless dimension changes listed in the description of ANVOL are made. Acres are totaled by 10-year age classes. A table of initial distribution of acres by 1-year and 10-year age classes is printed.

Growing stock volume is totaled in board feet and in cubic feet. Volume of an acre will be added to the total of only one of the two volume units. The unit will be board feet if the board-foot volume equals or exceeds the value of variable BFMRCH read by INPUT1. No volume will be computed for the acre if stand age is less than the specified minimum (AGMRCH).

Values of volume and money variables that are not zero at start of simulation are computed. These values are then assigned space in one of two 2-dimensional arrays to preserve them for printing by OUTPUT2.

Subroutine YEARS

YEARS is called each year of each game to simulate the changes in volume and value produced by tree growth, cutting, and other events. Changes and their order of occurrence are indicated by the comment statements of the source program. Several items are described in more detail below.

A specified area (IPLNT) is planted each year if nonstocked acres exist. Nonstocked acres are those deforested by fire or other catastrophe, and do not include harvested acres that will restock in the allotted time. Some or all harvested acres could be added to nonstocked area to simulate delays or failures in natural regeneration.

Age of each acre destroyed and added to nonstocked area is selected at random with a pseudorandom number generator of the form:

$$X_i \equiv AX_{i-1} + C \text{ (modulo M)}$$

(Greenberger 1961). All values are preset except for X_{i-1} which is designated as variable ANUL. The generator has a periodicity of 128. Values of ANUL from 0 to 127 may be selected at random to vary the pattern of loss.

Annual harvest in acres equals the constant or variable allowable cut less any losses of whole acres. Volume and value of shelterwood or seed trees, if any, are credited to the year of final cut FINL years after the regeneration cycle starts. The volume may increase or decrease during the regeneration period, and may be left unharvested. Desired results are obtained by entry of appropriate values for GROW and SHELT.

Subroutine YEARS was written to contain a series of dynamic events useful for many species and forest regions. The computations can easily be added to or modified to meet local needs or to test special alternatives. Unwanted alternatives in the program need not be removed. They can be bypassed by entry of appropriate values for variables not needed.

Subroutine OUTPUT1

Subroutine OUTPUT1 is called after the first year of each game and at the end of each decade. Numbers of acres by 1-year and 10-year stand age classes are printed. The tables correspond to that printed by AREAS just prior to start of a game.

Subroutine ANUAL

ANUAL is called every year of each game to compute 40 volume, area, or money totals and to store them for later use. Each total is stored in one of two 2-dimensional arrays. The first dimension identifies the variable, the second the year of a game to which the value applies. Numerical value of each year subscript is year plus one so year zero of a game can be included in the array. Array values are used in all subsequent subroutines of MANAGD.

Subroutine OUTPUT2

OUTPUT2 is called at the end of each game to print the results of each year of the game. Array values computed and stored by ANUAL are printed in 40 numbered columns that extend across four pages of standard Z-fold paper. Entries under column headings are printed at

the rate of 40 lines, or years, per page. Column headings on the pages produced by the test problem (appendix 2) and the variable lists in the source program of ANUAL (appendix 1) identify the variables reported.

Subroutine WORTH

Subroutine WORTH is called at the end of each game to discount all costs incurred and all income received. Value of the growing stock at the end of the simulation period is discounted to beginning of the period. The program discounts each future value at each of 20 compound interest rates. Rates range from 1.0 to 10.5 percent at intervals of 0.5 percent. The limits and interval can be changed by replacement of statements for CRATE(I) and CRATE(K) near the beginning of the subroutine.

WORTH prints a table that gives the present value of each of the following for each discount rate: (1) future growing stock, (2) all incomes, (3) sum of items 1 and 2, (4) all costs, and (5) item 3 minus the sum of item 4 and the value of the growing stock at beginning of the game. Net discounted revenues (present worths, item 5) may be plotted over discount rates to determine the internal rate of return applicable to the duration and conditions of the game.

Subroutine SUMRY

Subroutine SUMRY may be called at the end of each test to summarize results of the games of the test. If this option is used, SUMRY is also called at the end of each game to store specified volume and money values in a 3-dimensional array. Values stored correspond to the columns of OUTPUT2 that have the column numbers entered as KOL(I) by INPUT1. Any of the 40 numbered columns of OUTPUT2 (appendix 2) may be reproduced. Not more than six columns may be summarized during one test unless the dimensions of variables KOL(I) and SUMM(I,J,K) are increased. Results of as many as 10 games may be summarized at one time.

Results of the games of a test are printed together, with a separate page for each variable selected in advance.

Data Deck

Twenty-two types of punch cards, listed below, are used to enter initial values of variables into computer memory. Most cards are not optional and must be included in the data deck so READ statements will be executed properly. Four types are optional (6, 9, 10, 17) and are omitted from the data deck if the options are not to be exercised.

Data cards are read by four routines in the order in which the types are numbered. Two types are read once by the main program: (1) card type 1 or BATCH name, and (2) card type 2 or the number of tests to be performed in a batch. These identify the job and control the number of times the rest of the main routine is repeated.

Card types 3 to 10, inclusive, are read by INPUT1. One card of each type except types 6, 9, and 10 must be read once each test. Card types 6 (1 card), 9 (15 cards), and 10 (15 cards) are omitted from the data deck if their options are not to be used. The READ statement for card type 6, column numbers of items to be summarized by SUMRY, is bypassed when zero is punched for NKOLS on card type 4. Non-zero stumpage prices (BDPRI and/or CFPRI) on card type 8 cause the corresponding READ statements for variable prices of card types 9 or 10 to be skipped.

Subroutine YIELD reads four card types once each test. Types 11 to 14, inclusive, contain the values of tables 1 to 4 of this publication, or equivalent information applicable to other species or utilization standards. A type consists of three to eight punch cards. Change in the lowest site index of card type 12 (table 2) or in the minimum diameter of types 13 or 14 (tables 3 and 4) will require changes in the statements that compute array subscripts and probably in dimensions of the arrays.

Card types 15 to 22, inclusive, are read by INPUT2 once each game. Each type consists of one card except for optional type 17, which requires 10 punch cards. Statements that refer to card type 17, variable area by age classes, are bypassed when a non-zero value is punched for KAREA on card type 16.

Card types 18, 19, and 20 contain values for the price control procedure of Gould and O'Regan (1965). The number of acres harvested annually and the minimum cutting age can be made to vary with the current stumpage price of saw

logs. For example, in the second game of the test problem (appendix 2), 5 acres will be cut if price per thousand board feet does not exceed $12.00. Seven acres will be cut if stumpage price is $12.01 to $15.00, and 10 acres will be cut if price exceeds $15.00 but is less than $99.00. Sequence of harvest is from oldest acre to youngest, so full allowable cut will be taken only if sufficient acres above minimum cutting age are available. If price control is not wanted, entries for allowable cut in columns 1 to 4 of card type 19 and for cutting age in columns 1 to 8 of card type 20 are the desired constant limits. A critical price greater than the largest possible price (for example, $99.00) is entered in columns 1 to 8 of card type 18.

Order and Contents of the Data Deck

Card type	Optional	Read by	Frequency read	No. of cards	Variable name	Columns	Format	Description of variable
1	NO	Main	Batch	1	BATCH(I)	1-24	3A8	Descriptive name to identify output of one pass through the computer.
2	NO	Main	Batch	1	NTSTS	1-4	I4	Number of tests in the batch, each with a yield table.
3	NO	INPUT1	Test	1	DESCR(I)	1-40	5A8	Phrase to describe conditions of one test; to identify output.
4	NO	INPUT1	Test	1	NGAME	1-4	I4	Number of trials (games) to be operated in one test.
					NKOLS	5-8	I4	Number of columns of OUTPUT2 to be printed by SUMRY.
					NOYRS	9-12	I4	Number of years simulated in each game. Can be up to 150, but will usually be less.
5	NO	INPUT1	Test	1	AGEO	1-8	F8.3	Stand age at time of initial thinning. First age given in the yield table.
					SITE	9-16	F8.3	Site index. Base age and crown class same as used to derive growth equations.
					DENO	17-24	F8.3	Number of trees per acre at age AGEO.
					DBHO	25-32	F8.3	Average diameter breast high of the stand at age AGEO.
					ROTA	33-40	F8.3	Maximum age in the yield table; 1 year more than the maximum age expected during simulations. Cannot exceed 180 years.
					PRET	41-48	F8.3	Estimated percentage of the number of trees to be retained in initial thinning at age AGEO. Enter as a percent, e.g., 35.0.
					DLEV	49-56	F8.3	Density level for intermediate cuts after initial thinning. Based on table 1 of this publication and procedure described in YIELD.
					CYCL	57-64	F8.3	Interval between intermediate cuts. Equal to or a multiple of RINT.
					RINT	65-72	F8.3	Number of years for which a growth projection is made by the equation in YIELD.
					THIN	73-80	F8.3	Density level after initial thinning at age AGEO. Based on table 1 and procedure described in YIELD. May equal DLEV.

Card type	Optional	Read by	Frequency read	No. of cards	Variable name	Columns	Format	Description of variable
6	YES	INPUT1	Test	1	KOL(1)	1-4	I4	Numbers of the columns of OUTPUT2 to be printed by SUMRY. Maximum number of columns is 6 and must agree with NKOLS of card type 4. Column numbers are from 1 to 40, as given in the column headings of the printout of OUTPUT2 of the test problem.
					KOL(2)	5-8	I4	
					KOL(3)	9-12	I4	
					KOL(4)	13-16	I4	
					KOL(5)	17-20	I4	
					KOL(6)	21-24	I4	
7	NO	INPUT1	Test	1	AGMRCH	1-8	F8.3	Minimum stand age for an acre to be included in growing stock volume.
					BFMRCH	9-16	F8.3	Minimum volume in M bd. ft. for an acre to be included in board-foot growing stock volume.
					BFSALV	17-24	F8.3	Minimum volume per acre in M bd. ft. for commercial salvage after fire, wind, or other loss.
					COMCU	25-32	F8.3	Minimum cut per acre in merchantable cubic feet (table 3) for a cut to be of positive commercial value.
					COMBF	33-40	F8.3	Minimum cut per acre in M bd. ft. (table 4) for a cut to be of positive commercial value.
					BFPCT	41-48	F8.3	Ratio, as a decimal, of board-foot stumpage values of thinnings to board-foot stumpage values of harvests.
					CFPCT	49-56	F8.3	Ratio, as a decimal, of cubic-foot stumpage values of thinnings to cubic-foot stumpage values of harvests.
					GNTR	57-64	F8.3	Any number between 0 and 1023 used to generate random element of the increase from DBHT to DBHO. Enter number larger than 1024 to bypass this step.
8	NO	INPUT1	Test	1	BDPRI	1-8	F8.3	Stumpage price per M bd. ft. of final harvest if price is constant for all years of a game. Enter zero if variable prices will be entered with card type 10.
					CFPRI	9-16	F8.3	Stumpage price per 100 cubic feet of final harvest if price is constant for all years of a game. Enter zero if variable prices will be entered with card type 9.
9	YES	INPUT1	Test	15	PRICF(I)	1-80	10F8.3	Stumpage price per 100 cubic feet of harvest for each of 150 years. Used when CFPRI equals zero.
10	YES	INPUT1	Test	15	PRIBD(I)	1-80	10F8.3	Stumpage price per M bd. ft. of harvest for each of 150 years. Used when BDPRI equals zero.
11	NO	YIELD	Test	4	TABL1(K)	1-63	21F3.1	Basal area after thinning in relation to stand diameter. Values of table 1 copied on punch cards. Used with DLEV and THIN.
12	NO	YIELD	Test	3	TABL2(K,L)	1-75	25F3.1	Tree heights by age and site index class. Values of table 2 copied on punch cards.

Card type	Optional	Read by	Frequency read	No. of cards	Variable name	Columns	Format	Description of variable
13	NO	YIELD	Test	8	TABL3(K)	1-72	24F3.3	Factors for conversion of total cubic feet to merchantable cubic feet. Values of table 3 copied on punch cards.
14	NO	YIELD	Test	6	TABL4(K)	1-78	26F3.2	Factors for conversion of total cubic feet to board feet. Values of table 4 copied on punch cards.
15	NO	INPUT2	Game	1	GMNAM(I)	1-24	3A8	Descriptive name to identify each game of a test.
16	NO	INPUT2	Game	1	LAND	1-4	I4	Total acres in simulated working circle. Maximum is 1,000 acres.
					MOLD	5-8	I4	Age of oldest stand in the working circle at start of a game. Maximum is 179 years.
					NONSTK	9-12	I4	Number of acres non-stocked at start of a game. Does not include acres harvested the year before simulation begins if regeneration will take place in the allotted time.
					KAREA	13-16	I4	Number of acres in each 1-year age class when there is equal area in each class except for NONSTK.
					IPLNT	17-20	I4	Number of acres of NONSTK regenerated annually by direct seeding or planting at a cost of CPLT per acre.
17	YES	INPUT2	Game	10	IACRE(I)	1-72	18I4	Acres in each 1-year age class from 0 to not more than 179. Use if constant area KAREA is not wanted. Include NONSTK in IACRE(1) as well as on card type 16.
18	NO	INPUT2	Game	1	PRIDIV(I)	1-80	10F8.3	Limiting prices used to determine annual cut in acres and minimum cutting age.
19	NO	INPUT2	Game	1	MALCUT(I)	1-40	10I4	Allowable annual cut in acres. May vary with PRIDIV.
20	NO	INPUT2	Game	1	FMRCHD(I)	1-80	10F8.3	Minimum cutting age. May vary with PRIDIV.
21	NO	INPUT2	Game	1	SHELT	1-8	F8.3	Volume of shelterwood in M bd. ft. Enter zero if shelterwood or seed trees are not retained.
					RATE	9-16	F8.3	Rate of annual increase in costs. Enter zero if constant costs are desired. Otherwise, enter percentage as a decimal.
					CPLT	17-24	F8.3	Cost of regenerating 1 acre by seeding or planting.
					CTHN	25-32	F8.3	Cost per acre of precommercial thinning with stand conditions as specified for the simulation.
					CLOSS	33-40	F8.3	Cost per acre of cleanup after loss due to fire, wind, etc., when volume that can be salvaged is less than BFSALV.

Card type	Optional	Read by	Frequency read	No. of cards	Variable name	Columns	Format	Description of variable
					ACCST	41-48	F8.3	Total per acre for 1 year of the annual costs that can be assessed by area.
					CUCST	49-56	F8.3	Total of the costs that can be assessed against each 100 cubic feet harvested.
					BFCST	57-64	F8.3	Total of the costs that can be assessed against each M bd. ft. harvested.
					GROW	65-72	F8.3	Percentage increase or decrease in shelterwood volume during the regeneration period. Enter as a decimal. Enter -1.0 if shelterwood or seed trees will not be harvested.
					FINL	73-80	F8.3	Number of years between harvest cut and removal of shelterwood or seed trees. Enter zero if not to be removed.
22	NO	INPUT2	Game	1	DEFOR	1-8	F8.5	Percentage, as a decimal, of the area of forest lost annually to fire, wind, etc.
					ANUL	9-16	F8.5	Any number between 0 and 127 used to begin generation of pseudorandom numbers that represent ages ot stands lost to fire or other agency.

Description of Test Problem

The test problem that follows, (detailed in appendix 2) demonstrates most computations possible and the printed results obtained. It may be used to verify accuracy of punching of source decks and compatibility of the program with locally available compilers. Growth projections and volume conversions are based on relationships applicable to Black Hills ponderosa pine (Myers 1966). Data for costs, stumpage prices, and other items are hypothetical. Results of the simulations are therefore examples only, and do not apply to any real forest area.

Assume an area of 915 acres of managed stands that range from 0 (just harvested) to 129 years old. There are 7 acres in each 1-year age class, plus 5 acres of old burn and windthrow that must be seeded or planted. Annual losses to fire, wind, and other agencies average 0.04 percent of the forested area. Site index of all acres is 60 feet.

Stands will be regenerated by two-cut shelterwood, and will be thinned several times during a rotation. Shelterwood volume will average 4,000 board feet per acre, and will increase an average of 3 percent of initial volume each of the 10 years before the final cut. Stands will be thinned for the first time when they are 30 years old. At this age, there will be 1,000 trees per acre that average 4.5 inches in diameter. Initial thinning will be to level 120, or 120/80 times the basal areas in table 1. Rethinnings at 20-year intervals will be to level 100, or 100/80 times tabulated basal areas. Stands are not expected to ever become 150 years old.

Potential prices of two products have been estimated for each of the next 30 years. The stumpage price of 100 cubic feet of roundwood from mature trees or from thinnings is expected to be $2.50 throughout the period. Price of a thousand board feet of saw logs is expected to vary annually, as shown in column 28 of the printout of annual results (appendix 2). Saw logs from thinnings will sell for 85 percent of the price of logs from harvest cuts. A minimum commercial cut of saw logs will be 3,000 board feet per acre, except that 1,500 board feet may be salvaged from an acre after fire or other catastrophe. Minimum commercial cut of roundwood will be 400 cubic feet.

Current value of the growing stock will be computed only for stands at least 40 years old. Value will be computed for cubic volume for acres with less than 1,500 board feet. Otherwise, board-foot volumes will be used.

Present costs of various operations are as follows:

- Costs per acre—
  - Seeding—$30
  - Precommercial thinning—$25
  - Cleanup where salvage is not possible—$25
  - Annual costs—$0.20
- Costs assessed against volume sold—
  - Per 100 cubic feet—$0.05
  - Per thousand board feet—$1.56

These costs are expected to increase at a rate of 1 percent annually. Resources are available to seed 1 acre each year.

Two possible means of setting the allowable annual cut are to be tested. One alternative is to harvest 7 acres annually, regardless of price fluctuations. Stands less than 130 years old will not be cut. A second possibility is to harvest: (1) 5 acres if stumpage price per thousand board feet is $12 or less, (2) 7 acres if the price is $12.01 to $15, and (3) 10 acres if price exceeds $15 per thousand. Stands less than 130 years old will not be cut except that the minimum age will be 120 years when stumpage price exceeds $15. Periodic production in board feet and net income will be compared. Values needed to obtain present worths will be computed.

Data cards to enter these values into computer memory must contain the alphameric characters given in the following list. Decimal points are shown for numbers in F-format to indicate the way in which percentages and money values are entered. Spaces between numbers do not correspond to the blank columns of the data cards. Card types 9 and 17 are not included in the data deck because the options that require them will be bypassed.

Test conditions and results of the simulations are printed on seven types of pages (appendix 2). The first two types, (1) a yield table and (2) tables of volumes per acre for each year of stand age, appear once because one test was run. Four types of pages are printed for each of the two games. The seventh type of page appears once at the end of the printout to summarize specified results of the two games.

The two sheets of "alternatives for this game" show the values used in the simulations, including the different allowable cuts and cutting ages tested.

Distributions of acres by age classes (page type four) appear on two sets of pages, one set for each game. Pages for year zero show 7 acres in each of 129 1-year age classes. Age class zero has an additional 5 acres of non-stocked area. Acreages are the same for both games, because initial distributions were the same. Similar pages are printed at the end of the first year of each game and at the end of each decade. For brevity, only the page printed after the thirtieth year of each game is reproduced in appendix 2. After 30 years of simulation, losses and direct seeding have modified the pattern of 7-acre units. In addition, area distribution of the second game has been changed by the variable annual cuts.

The fifth type of page is a set of four pages for each game. Values in many of the 40 numbered columns differ between games. Board-foot volumes are unequal because of variations in annual cuts of mature timber during the second game. This caused money values to differ from those reported for the first game.

A page of discounted money values, the sixth type of page, is printed for each game. Rate of return was about the same for both games. Both operations were profitable. In addition, the forest would probably be in good condition to produce other products, especially recreation.

Last, specified values from each game were printed together for convenience in interpretation of results. Total volume in board feet of all cuts plus growing stock (column 10) was higher after 30 years where equal areas were cut each year. Differences were never great; variable annual cuts produced the larger volume after 20 years. Total net worth (column 40) was greater where annual cuts varied with price, except for several of the earlier years.

It must be emphasized that results of these or other simulations depend on: (1) duration of the games, (2) values entered for the various variables, (3) assumptions made, and (4) degree to which the model represents reality.

The above information, additional data, and knowledge of local conditions would help the forest manager decide how he might best conduct his business. Money yields would encourage the manager to vary annual cuts in

Data Deck for Test Problem

Card type	Contents of Cards									
1	TEST PROBLEM									
2	1									
3	MANAGED, THINNED AGE 30									
4	2	2	30							
5	30.	60.	1000.	4.5	150.	40.	100.	20.	10.	120.
6	10	40								
7	40.	1.5	1.5	400.	3.0	.85	1.0	2222.		
8	0.0	2.50								
10	(Column 28 of printout by OUTPUT2)									
11	(Table 1 of this publication)									
12	(Table 2 of this publication)									
13	(Table 3 of this publication)									
14	(Table 4 of this publication)									
15	EQUAL AREAS CUT ANNUALLY									
16	915	129	5	7	1					
18	99.	0	0	0	0	0	0	0	0	0
19	7	0	0	0	0	0	0	0	0	0
20	130.	0	0	0	0	0	0	0	0	0
21	4.0	.01	30.	25.	25.	.20	.05	1.56	.30	10.0
22	.0004	21.								
15	VARY CUT WITH PRICE									
16	915	129	5	7	1					
18	12.	15.	99.	0	0	0	0	0	0	0
19	5	7	10	0	0	0	0	0	0	0
20	130.	130.	120.	0	0	0	0	0	0	0
21	4.0	.01	30.	25.	25.	.20	.05	1.56	.30	10.0
22	.0004	21.								

response to changes in stumpage price. Highly variable annual cuts and equally variable net incomes would suggest that additional simulations be run to test other alternatives. Cost of computer time need not restrict the manager in his search for information. The test problem was compiled and run in 26 seconds of central processor time and 9 seconds of input-output time.

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*Address requests for copies to the originating office.

APPENDIX I
Program MANAGD

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DEFINITIONS OF VARIABLES

ACAGE(I) = ONE ACRE, WITH AGE OF NUMERICAL VALUE AND IDENTIFIED BY
   SUBSCRIPT
ACCST = ANNUAL COST PER ACRE
AGEO = INITIAL AGE IN YIELD TABLE
AGMRCH = MINIMUM AGE FOR STAND TO BE INCLUDED IN GROWING STOCK
ANBDF(I) = M BD. FT. PER ACRE AT END OF EACH YEAR
ANCUV(I) = CU.FT. STANDING PER ACRE AT END OF EACH YEAR
ANNET = ANNUAL NET INCOME
ANUL = NUMBER BETWEEN D AND 127 USED TO START GENERATION OF
   PSEUDORANDOM NUMBERS
BASC = BASAL AREA REMOVED PER ACRE
BASO = BASAL AREA PER ACRE BEFORE THINNING
BAST = BASAL AREA PER ACRE AFTER THINNING
BATCH(I) = JOB NAME
BDFC(I) = M BD. FT. REMOVED PER ACRE
BDFO(I) = M BD. FT. PER ACRE BEFORE THINNING
BDFT(I) = M BD. FT. PER ACRE AFTER THINNING
BDPRI = CONSTANT STUMPAGE PRICE PER M BD. FT.
BFCST = COSTS PER M BD. FT. HARVESTED
BFMRCH = MINIMUM VOLUME TO BE INCLUDED IN BD.FT. GROWING STOCK
BFPCT = PCT. TO CONVERT BD.FT. PRICE FOR THINNINGS
BFSALV = MINIMUM BD.FT. FOR COMMERCIAL SALVAGE
CFMC(I) = MERCHANTABLE CU.FT. REMOVED PER ACRE
CFMO(I) = MERCHANTABLE CU.FT. PER ACRE BEFORE THINNING
CFMT(I) = MERCHANTABLE CU.FT. PER ACRE AFTER THINNING
CFPCT = PCT. TO CONVERT CU.FT. PRICE FOR THINNINGS
CFPRI = CONSTANT STUMPAGE PRICE PER 10D CU.FT.
CLOSS = COST OF CLEANUP OF VOLUME NOT SALVAGED
COMBF = MINIMUM COMMERCIAL CUT IN BD. FT.
COMCU = MINIMUM COMMERCIAL CUT IN CU. FT.
CPLT = PLANTING  COST PER ACRE
CRATE(I) = INTEREST RATES FOR DISCOUNTING
CSTAC = ANNUAL COSTS BASED ON AREA
CSTVL = ANNUAL COSTS FOR VOLUME HARVESTED
CTHN = COST PER ACRE OF PRECOMMERCIAL THINNING
CUCST = COSTS PER 1DO CUBIC FEET HARVESTED
CUTAGE = MINIMUM CUTTING AGE
CYCL = INTERVAL BETWEEN INTERMEDIATE CUTS
DBHO = AVERAGE STAND D.B.H. BEFORE THINNING
DBHT = AVERAGE STAND D.B.H. AFTER THINNING
DEFOR = PERCENTAGE(AS DECIMAL) OF NUMBER OF ACRES LOST ANNUALLY
DENC = TREES REMOVED PER ACRE
DENO = TREES PER ACRE BEFORE THINNING
DENT = TREES PER ACRE AFTER THINNING
DESCR(I) = DESCRIPTION OF TEST CONDITIONS
DISC(I) = DISCOUNTED VALUE OF FUTURE COSTS
DISG(I) = DISCOUNTED VALUE OF GROWING STOCK
DISI(I) = DISCOUNTED VALUE OF FUTURE INCOMES
DLEV = GROWING STOCK LEVEL FOR SECOND AND SUBSEQUENT THINNINGS
FINL = YEARS BETWEEN HARVEST AND REMOVAL OF SHELTERWOOD
FMRCHD(I) = MINIMUM CUTTING AGE BASED ON PRICE
GMNAM(I) = NAME OF THE GAME
GNTR = PSEUDORANDOM NUMBER GENERATOR. VALUE D TD 1D23.
GROW = GROWTH RATE OF SHELTERWOOD
GSVALB = DOLLAR VALUE OF BD.FT. GROWING STOCK
GSVALC = DOLLAR VALUE OF CU.FT. GROWING STOCK
GVLBF = GROWING STOCK VOLUME, M BD. FT.
GVLCU = GROWING STOCK VOLUME, CU.FT.
HTSO = TREE HEIGHT BEFORE THINNING
HTST = TREE HEIGHT AFTER THINNING
IACRE(I) = ACRES OF WORKING CIRCLE IN EACH 1-YEAR AGE CLASS, AT
   START OF GAME
IALCUT = NUMBER OF ACRES ALLOWABLE ANNUAL CUT
IGAME = NUMBER OF GAME
IPLNT = NUMBER OF NON-STOCKED ACRES REGENERATED ANNUALLY
ISUM(I) = TOTAL ACRES EACH 1D-YR AGE CLASS
ITEST = NUMBER OF TEST
IVAR(I,J) = VARIABLES TO BE PRINTED BY OUTPUT2
IYEAR = YEAR WITHIN RUN OF A GAME
KAREA = EQUAL AREA OF EACH 1-YEAR AGE CLASS
KOL(I) = COLUMN NUMBER(FROM OUTPUT2) PRINTED BY SUMRY
KOUNT = COUNT OF ACRES HARVESTED, PLUS ONE
LAND = TOTAL ACRES IN SIMULATED WORKING CIRCLE
LAST = NUMBER OF LAST ACRE HARVESTED
MALCUT(I) = ANNUAL ALLOWABLE CUT BASED ON PRICE
MOLD = AGE OF OLDEST ACRE IN WORKING CIRCLE AT START OF A GAME
NACRE(I) = ACRES OF WORKING CIRCLE IN EACH 1-YEAR AGE CLASS,
   DURING A GAME
NGAME = NUMBER OF GAMES PER TEST
NKOLS = NUMBER OF COLUMNS OF OUTPUT2 TO BE PRINTED BY SUMRY
NONSTK = NONSTOCKED AREA
NOYRS = NUMBER OF YEARS IN A GAME
NTSTS = NUMBER OF TESTS IN BATCH
PRET = PERCENTAGE OF TREES RETAINED AFTER INITIAL THINNING
PREV(I) = PRESENT VALUE OF GROWING STOCK AND INCOMES
PRIBD(I) = VARIABLE STUMPAGE PRICE PER M BD. FT.
PRICF(I) = VARIABLE STUMPAGE PRICE PER 1DD CU.FT.
PRIDIV(I) = PRICES USED TO SET POLICY
PWTH(I) = PRESENT WORTH
RATE = RATE OF ANNUAL INCREASE IN COSTS
RETHV = ANNUAL RETURN FROM FINAL HARVEST
RETRN = ANNUAL INCOME FROM STUMPAGE
RETTH = ANNUAL RETURN FROM THINNINGS
RINT = NUMBER OF YEARS FOR WHICH GROWTH PROJECTION IS MADE
ROTA = LONGEST POSSIBLE ROTATION IN YIELD TABLE
SCPLT = TOTAL ANNUAL PLANTING COST
SCTHN = SUM OF PRECOMMERCIAL THINNING COSTS
SHELT = M BD. FT. RETAINED AS SEED TREES OR SHELTERWOOD
SHWD = VOLUME OF SHELTERWOOD AT FINAL CUT
SITE = SITE INDEX
SUMM(I,J,K) = ARRAY FOR PRINTING BY SUMRY
C     TCOST = TOTAL ANNUAL COSTS
C     THIN = GROWING STOCK LEVEL FOR INITIAL THINNING
C     TOTC = TOTAL CUBIC FEET REMOVED PER ACRE
C     TOTO = TOTAL CUBIC FEET PER ACRE BEFORE THINNING
C     TOTT = TOTAL CUBIC FEET PER ACRE AFTER THINNING
C     VAR(I,J) = VARIABLES TO BE PRINTED BY OUTPUT2
C     VBHV = BOARD-FOOT VOLUME FROM HARVESTS
C     VBTH = BOARD-FOOT VOLUME FROM THINNING
C     VCHV = CUBIC-FOOT VOLUME FROM HARVESTS
C     VCTH = CUBIC-FOOT VOLUME FROM THINNING
C     VLBF = VOLUME HARVESTED, M BD. FT.
C     VLCU = VOLUMF HARVESTED, CU.FT.
C     YRLOS = NUMBER OF ACRES LOST ANNUALLY
C
      COMMON ACCST,AGEO,AGMRCH,ANBDF(181),ANCUV(181),ANNET,BATCH(3),BDFC
     1(18D),BDFO(18D),BFCST,CFMC(18O),CFMO(18D),CSTAC,CSTVL,CUCST,CUTAGE
     2,DBHO,DENO,DESCR(5),DLEV,FMRCHD(10),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(18D),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,15D),IYEAR,
     4KOL(6),LAND,LAST,MALCUT(1D),MOLD,NACRE(18O),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRIBD(15D),PRICF(15D),PRIDIV(1D),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,15D),VLBF,VLCU,ACAGE(10DD),CYCL,KOUNT,DEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,BFSALV,COMCU,COMBF,BFPCT,GNTR
      READ (5,1) (BATCH(I),I=1,3)
    1 FORMAT (3A8)
      READ (5,2) NTSTS
    2 FORMAT (I4)
      DO 8 ITEST=1,NTSTS
      CALL INPUT1
C
C     PRINT YIELD TABLE AND COMPUTE VOLUME FOR EACH YEAR OF STAND AGE
C
      CALL YIELD
      CALL ANVOL
C
C     OPERATE SYSTEM FOR DESIRED NUMBER OF GAMES
C
      DO 8 IGAME=1,NGAME
      CALL INPUT2
C
C     CREATE ACRES IN EACH AGE CLASS
C
      CALL AREAS
      IJK = D
C
C     OPERATE SYSTEM FOR DESIRED NUMBER OF YEARS
C
      DO 7 IYEAR=1,NOYRS
      CALL YEARS
C
C     PRINT ACRES IN EACH AGE CLASS FOR FIRST YEAR AND END OF
C     EACH DECADE
C
      IF (IYEAR .LE. 1) GO TO 3
      IF (IJK .EQ. 1D) GO TO 4
      GO TO 6
    3 IJK = 1
      GO TO 5
    4 IJK = D
    5 CALL OUTPUT1
    6 IJK = IJK + 1
      CALL ANUAL
    7 CONTINUE
C
C     PRINT VOLUMES AND VALUES FOR EACH YEAR
C
      CALL OUTPUT2
      CALL WORTH
C
C     SUMMARIZE DESIRED NUMBER OF COLUMNS OF OUTPUT2
C
      IF (NKOLS .LE. D) GO TO 8
      CALL SUMRY
    8 CONTINUE
      CALL EXIT
      END
      SUBROUTINE INPUT1
      COMMON ACCST,AGEO,AGMRCH,ANBDF(181),ANCUV(181),ANNET,BATCH(3),BDFC
     1(18D),BDFO(18D),BFCST,CFMC(18D),CFMO(18D),CSTAC,CSTVL,CUCST,CUTAGE
     2,DBHO,DENO,DESCR(5),DLEV,FMRCHD(1D),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(18O),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,15D),IYEAR,
     4KOL(6),LAND,LAST,MALCUT(10),MOLD,NACRE(18D),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRIBD(150),PRICF(15D),PRIDIV(1D),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,1D),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,15D),VLBF,VLCU,ACAGE(10DD),CYCL,KOUNT,DEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,BFSALV,COMCU,COMBF,BFPCT,GNTR
C
C     SET INITIAL VALUES OF ZERO
C
      DO 1 I=1,6
    1 KOL(I) = D
      DO 2 I=1,15D
      PRIBD(I) = D.D
    2 PRICF(I) = D.D
      DO 3 I=1,181
      ANBDF(I) = D.D
    3 ANCUV(I) = O.D
      DO 4 I=1,6
      DO 4 J=1,25
      DO 4 K=1,1D
    4 SUMM(I,J,K) = D.O
C
C     READ VALUES THAT DO NOT CHANGE WITHIN A TEST
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```
C
      READ (5,5) (DESCR(I),I=1,5)
    5 FORMAT (5A8)
      READ (5,6) NGAME,NKOLS,NOYRS
    6 FORMAT (20I4)
      READ (5,7) AGEO,SITE,DENO,DBHO,ROTA,PRET,DLEV,CYCL,RINT,THIN
    7 FORMAT (10F8.3)
      IF (NKOLS .LE. 0) GO TO 8
      READ (5,6) (KOL(I),I=1,NKOLS)
    8 READ (5,7) AGMRCH,BFMRCH,BFSALV,COMCU,COMBF,BFPCT,CFPCT,GNTR
      READ (5,7) BDPRI,CFPRI
C
C     CREATE A SERIES OF CONSTANT OR VARIABLE PRICES
C
      IF (CFPRI .NE. 0.0) GO TO 9
      READ (5,7) (PRICF(I),I=1,150)
      GO TO 11
    9 DO 10 I=1,150
   10 PRICF(I) = CFPRI
   11 IF (BDPRI .NE. 0.0) GO TO 12
      READ (5,7) (PRIBD(I),I=1,150)
      GO TO 14
   12 DO 13 I=1,150
   13 PRIBD(I) = BDPRI
   14 RETURN
      END
      SUBROUTINE YIELD
      COMMON ACCST,AGEO,AGMRCH,ANBDF(181),ANCUV(181),ANNET,BATCH(3),BDFC
     1(180),BDFO(180),BFCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,DBHO,DENO,DESCR(5),DLEV,FMRCHO(10),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LAND,LAST,MALCUT(10),MOLD,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRIBD(150),PRICF(150),PRIDIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VLBF,VLCU,ACAGE(1000),CYCL,KOUNT,DEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,BFSALV,COMCU,COMBF,BFPCT,GNTR
      DIMENSION TABL1(81),TABL2(4,18),TABL3(192),TABL4(156)
      BDFT = 0.0
      CFMT = 0.0
      JBDFC = 0
      JBDFO = 0
      JBDFT = 0
      JCFMC = 0
      JCFMO = 0
      JCFMT = 0
      DO 1 I=1,180
      BDFC(I) = 0.0
      BDFO(I) = 0.0
      CFMC(I) = 0.0
    1 CFMO(I) = 0.0
C
C     READ HEIGHTS,DENSITIES,VOLUME CONVERSION FACTORS
C
      READ (5,2) (TABL1(K),K=1,81)
    2 FORMAT (21F3.1)
      READ (5,3) ((TABL2(K,L),K=1,4),L=1,18)
    3 FORMAT (25F3.1)
      READ (5,4) (TABL3(K),K=1,192)
    4 FORMAT (24F3.3)
      READ (5,5) (TABL4(K),K=1,156)
    5 FORMAT (26F3.2)
      N1 = AGEO
      N = AGEO
      BASO = DENO * 0.0054542 * DBHO * DBHO
C
C     OBTAIN HTSO
C
      TEN = 10.0
      ISITE = (SITE/TEN - 3.0) + 0.01
      IAGEO = (AGEO/TEN) + 0.01
      HTSO = TABL2(ISITE,IAGEO)
      TOTO = (0.4047 * BASO * HTSO) + (25.5970 * DBHO) - 191.6433
C
C     COMPUTE MERCH. CU.FT. IF DBH IS AT LEAST 5.0 INCHES
C
      IF (DBHO .LT. 5.0) GO TO 6
      IDBHO = ((DBHO - 5.0) * 10.0) + 1.01
      XDBHO = TABL3(IDBHO)
      CFMO(N) = TOTO * XDBHO
C
C     COMPUTE BD.FT. IF DBH IS AT LEAST 8.0 INCHES
C
      IF (DBHO .LT. 8.0) GO TO 6
      JDBHO = ((DBHO - 8.0) * 10.0) + 1.01
      YDBHO = TABL4(JDBHO)
      BDFO(N) = TOTO * YDBHO
C
C     COMPUTE DBH AFTER INITIAL THINNING
C
    6 DO 11 J=1,100
      PDBHE = 0.95462*ALOG10(DBHO) - 0.10640*ALOG10(PRET) + 0.26959
      DBHE = 10.0 ** PDBHE
      IDBHE = DBHE * 10.0 + 0.5
      DBHE = IDBHE
      DBHE = DBHE/TEN
      DENE = DENO * (PRET/100.0)
      BASE = (0.0054542 * DBHE * DBHE) * DENE
      BREAK = 49.9 * THIN/80.0
      IF (BASE .GT. BREAK) GO TO 7
      DBHP = (80.0/THIN) * (0.08733 * BASE) + 0.92247
      GO TO 8
    7 DBHP = (80.0/THIN) * (0.10938 * BASE) - 0.17858
    8 IDBHP = DBHP * 10.0 + 0.5
      DBHP = IDBHP
      DBHP = DBHP/TEN
      IF (DBHP - DBHE) 9,12,10
    9 PRET = PRET + PRET * 0.02
      GO TO 11
   10 PRET = PRET - PRET * 0.02
   11 CONTINUE
   12 DBHT = DBHE
C
C     COMPUTE VALUES AFTER INITIAL THINNING
C
      JDBHT = ((DBHT - 2.0) * 10.0) + 1.01
      SQFT = TABL1(JDBHT)
      BAST = (THIN/80.0) * SQFT
C
C     ENTER LOOP FOR ALL REMAINING COMPUTATIONS AND PRINTOUT
C
      DO 26 I=1,100
      DENT = BAST/(0.0054542 * DBHT * DBHT)
      HTST = HTSO
      TOTT = (0.4047 * BAST * HTST) + (25.5970 * DBHT) - 191.6433
C
C     COMPUTE MERCH. CU.FT. IF DBH IS AT LEAST 5.0 INCHES
C
      IF (DBHT .LT. 5.0) GO TO 13
      IDBHT = ((DBHT - 5.0) * 10.0) + 1.01
      XDBHT = TABL3(IDBHT)
      CFMT = TOTT * XDBHT
C
C     COMPUTE BD.FT. IF DBH IS AT LEAST 8.0 INCHES
C
      IF (DBHT .LT. 8.0) GO TO 13
      JDBHT = ((DBHT - 8.0) * 10.0) + 1.01
      YDBHT = TABL4(JDBHT)
      BDFT = TOTT * YDBHT
C
C     CHANGE MODE AND ROUND OFF FOR PRINTING
C
   13 JDENO = DENO
      JHTSO = HTSO
      JTOTO = TOTO + 0.5
      JBASO = BASO + 0.5
      JCFMO = CFMO(N) + 0.5
      JBDFO = (BDFO(N)/TEN) + 0.5
      JBDFO = JBDFO * 10
      JDENT = DENT
      JHTST = HTST
      JTOTT = TOTT + 0.5
      JDENC = JDENO - JDENT
      JCFMT = CFMT + 0.5
      CFMT = JCFMT
      IF (JCFMT .GT. JCFMO) JCFMO = JCFMT
      CFMO(N) = JCFMO
      JBDFT = (BDFT/TEN) + 0.5
      JBDFT = JBDFT * 10
      BDFT = JBDFT
      BDFT = BDFT * .001
      IF (JBDFT .GT. JBDFO) JBDFO = JBDFT
      BDFO(N) = JBDFO
      BDFO(N) = BDFO(N) * .001
      JBAST = BAST + 0.5
      JBASC = JBASO - JBAST
      JTOTC = JTOTO - JTOTT
      JCFMC = JCFMO - JCFMT
      IF (JCFMC .LE. 0) JCFMC = 0
      CFMC(N) = JCFMC
      JBDFC = JBDFO - JBDFT
      IF (JBDFC .LE. 0) JBDFC = 0
      BDFC(N) = JBDFC
      BDFC(N) = BDFC(N) * .001
      IF (I .GE. 2) GO TO 19
C
C     WRITE HEADINGS FOR YIELD TABLE
C
      WRITE (6,14) SITE,CYCL,DLEV
   14 FORMAT (1H1,////,28X,81HYIELDS PER ACRE OF MANAGED, EVEN-AGED STAN
     1DS OF PONDEROSA PINE IN THE BLACK HILLS/1H ,35X,10HSITE INDEX,F3.0
     2,1H,,F4.0,19H-YEAR CUTTING CYCLE,1H,,15H DENSITY LEVEL ,F4.0,///)
      WRITE (6,15)
   15 FORMAT (1H0,25X,38HENTIRE STAND BEFORE AND AFTER THINNING,28X,26HP
     1ERIODIC CUT AND MORTALITY)
      WRITE (6,16)
   16 FORMAT (1H0,9X,5HSTAND,10X,5HBASAL,3X,7HAVERAGE,2X,7HAVERAGE,3X,5H
     1TOTAL,3X,9HMERCHANT-,3X,9HSAWTIMBER,9X,5HBASAL,4X,5HTOTAL,3X,9HMER
     2CHANT-,3X,9HSAWTIMBER)
      WRITE (6,17)
   17 FORMAT (1H ,10X,3HAGE,4X,5HTREES,3X,4HAREA,4X,6HD.B.H.,3X,6HHEIGHT
     1,2X,6HVOLUME,2X,11HABLE VOLUME,4X,6HVOLUME,3X,5HTREES,3X,4HAREA,3X
     2,6HVOLUME,2X,11HABLE VOLUME,4X,6HVOLUME)
      WRITE (6,18)
   18 FORMAT (1H ,8X,7H(YEARS),3X,3HNO.,3X,6HSQ.FT.,4X,3HIN.,6X,3HFT.,4X
     1,6HCU.FT.,5X,6HCU.FT.,8X,3HMBF,5X,3HNO.,3X,6HSQ.FT.,2X,6HCU.FT.,5X
     2,6HCU.FT.,8X,3HMBF)
   19 WRITE (6,20) AGEO,JDENO,JBASO,DBHO,JHTSO,JTOTO,CFMO(N),BDFO(N)
   20 FORMAT (1H0,9X,F4.0,4X,I5,2X,I4,5X,F5.1,5X,I3,4X,I5,6X,F5.0,6X,F6.
     13)
      IF (AGEO.GE.ROTA) GO TO 27
      WRITE (6,21) AGEO,JDENT,JBAST,DBHT,JHTST,JTOTT,CFMT,BDFT,JDENC,JBA
     1SC,JTOTC,CFMC(N),BDFC(N)
   21 FORMAT (1H ,9X,F4.0,4X,I5,2X,I4,5X,F5.1,5X,I3,4X,I5,6X,F5.0,6X,F6.
     13,4X,I5,3X,I3,5X,I4,6X,F4.0,8X,F5.3)
C
C     COMPUTE VALUES FOR EACH PERIOD. THIN AS SPECIFIED
C
      IK = CYCL/RINT
      DO 23 L=1,IK
      AGEO = AGEO + RINT
      N = AGEO
      IF (AGEO . GT . ROTA) GO TO 27
      DBHO = 1.0097*DBHT + 0.0096*SITE - 1.5766*ALOG10(BAST) + 3.3021
      IDBHO = DBHO * 10.0 + 0.5
      DBHO = IDBHO
      DBHO = DBHO/TEN
```

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C
C     ADD RANDOM ELEMENT TO PREDICTED OBHO,IF DESIRED
C
      IF (GNTR .GT. 1D24.D) GD TO 11D
  10D IOIV = (17.D * GNTR + 3.D)/1D24.D
      NGNTR = GNTR
      GNTR = (17 * NGNTR + 3) - 1D24 * IDIV
      IF (GNTR .GT. 1DDD.D) GO TD 10D
      IF (GNTR .LT. D.0) GD TO 1DD
      A1 = GNTR/1DD.D
      A2 = A1 * A1
      RES = D.9565 * A1 - D.D523 * A2 - 0.0D63 * A1 * A2 + D.DDDB4 * A2
     1*A2 - 3.3DD9
      IRES = RES
      IF (RES .LT. D.D) IRES = RES - D.5
      IF (RES .GT. D.D) IRES = RES + D.5
      ADJ = IRES
      OBHD = DBHD + ADJ/TEN
  11D DEND = DENT
      BASO = DEND * (0.DD54542 * DBHD * D8HO)
      ISITE = (SITE/TEN - 3.D) + D.D1
      IAGEO = (AGED/TEN) + D.D1
      HTSD = TABL2(ISITE,IAGED)
      TOTD = D.4D47 * BASO * HTSD + 25.597D * D8HD - 191.6433
C
C     COMPUTE MERCH. CU.FT. IF DBH IS AT LEAST 5.0 INCHES
C
      IF (DBHD .LT. 5.D) GD TD 22
      IO8HD = ((DBHD - 5.0) * 1D.D) + 1.D1
      XDBHD = TABL3(IDBHO)
      CFMO(N) = TDTO * XDBHD
C
C     CDMPUTE BD.FT. IF DBH IS AT LEAST 8.0 INCHES
C
      IF (DBHD .LT. B.D) GO TD 22
      JO8HD = ((O8HD - B.D) * 1D.D) + 1.D1
      YOBHD = TABL4(JDBHD)
      BDFD(N) = TOTD * YDBHO
   22 IF (L .EQ. IK) GO TD 24
C
C     WRITE VALUES FDR END DF PERIDD IF THINNING NDT DUE
C
      KDEND = OENO
      KHTSO = HTSO
      KBASD = 8ASO + 0.5
      KTOTO = TOTD + 0.5
      JCFMO = CFMD(N) + D.5
      CFMO(N) = JCFMD
      JBDFO = (BOFD(N)/TEN) + D.5
      JBOFO = JBOFO * 10
      BOFO(N) = JBOFO
      BDFD(N) = BDFO(N) * .OD1
      WRITE (6,20) AGEO,KOENO,K8ASO,OBHO,KHTSO,KTOTO,CFMD(N),8DFO(N)
      DBHT = OBHO
      8AST = BASO
   23 CONTINUE
C
C     INCREASE D8H AS RESULT OF THINNING ANO CDMPUTE PDST-THINNING
C     VALUES
C
   24 DBHT = OBHO + 0.4
      IF (O8HT .GE. 1D.D) GO TO 25
      JDBHT = ((D8HT - 2.D) * 1D.D) + 1.D1
      SQFT = TABL1(JOBHT)
      BAST = (DLEV/BD.D) * SQFT
      GO TO 26
   25 BAST = OLEV
   26 CONTINUE
   27 RETURN
      END
      SUBROUTINE ANVOL
      COMMON ACCST,AGEO,AGMRCH,ANBOF(1B1),ANCUV(181),ANNET,BATCH(3),BDFC
     1(18O),BOFO(18D),BFCST,CFMC(1BD),CFMO(18D),CSTAC,CSTVL,CUCST,CUTAGE
     2,OBHO,DENO,DESCR(5),DLEV,FMRCHO(1D),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(18D),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,15D),IYEAR,
     4KOL(6),LAND,LAST,MALCUT(1D),MDLD,NACRE(1BD),NGAME,NKOLS,N1,NDNSTK,
     5NDYRS,PRET,PRIBO(150),PRICF(150),PRIDIV(1O),RETRN,RDTA,RATE,GRDW,
     6SITE,SUMM(6,25,1D),TCOST,SHELT,YRLDS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,15D),VLBF,VLCU,ACAGE(1ODD),CYCL,KOUNT,DEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,8FMRCH,8FSALV,COMCU,COMBF,8FPCT,GNTR
      IROT = ROTA
      INT = RINT
      NVOL = ((IROT - N1)/INT) + 1
      K = NVOL - 1
C
C     INTERPOLATE BETWEEN VALUES FROM YIELO TABLE
C
      DO 1 L=1,K
      DO 1 J=1,INT
      NN = J + N1 + (L - 1) * INT
      RJ = J - 1
      N = N1 + (L - 1) * INT
      ANCUV(NN) =CFMD(N)-CFMC(N)+(RJ/RINT)*(CFMD(N+INT)-CFMD(N)+CFMC(N))
      ANBDF(NN) =BOFO(N)-8OFC(N)+(RJ/RINT)*(8OFO(N+INT)-8OFD(N)+BDFC(N))
    1 CONTINUE
C
C     WRITE TABLE HEAOINGS
C
      WRITE (6,2) SITE,CYCL,THIN,OLEV
    2 FORMAT (1H1,////,41X,51HGROWING STDCK DF MANAGED BLACK HILLS PONDE
     1ROSA PINE/1H ,47X,1DHSITE INOEX,F3.O,1H,,F4.D,19H-YEAR CUTTING CYC
     2LE/1H ,53X,14HDENSITY LEVEL-,F4.D,1X,3HANO,F4.D)
      WRITE (6,3)
    3 FORMAT (1HD,43X,44HVOLUMES PRESENT PER ACRE AT END DF EACH YEAR)
      WRITE (6,4)
    4 FORMAT (1H ,54X,23HMERCHANTABLE CUBIC FEET/1HD,64X,4HYEAR/1H ,14X,
     16HDECAOE,9X,1HD,9X,1H1,9X,1H2,9X,1H3,9X,1H4,9X,1H5,9X,1H6,9X,1H7,9
     2X,1H8,9X,1H9,//)
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```
      K = D
C
C     WRITE CUBIC FEET PER ACRE FDR EACH YEAR
C
      WRITE (6,5) K,(ANCUV(NN),NN=1,1D)
    5 FORMAT (1H ,I2D,F13.1,9F1D.1)
      IJ = IRDT/1D - 1
      OD 6 J=1,IJ
      NN = 1D * J + 1
      WRITE (6,5) J,ANCUV(NN),ANCUV(NN+1),ANCUV(NN+2),ANCUV(NN+3),ANCUV(
     1NN+4),ANCUV(NN+5),ANCUV(NN+6),ANCUV(NN+7),ANCUV(NN+B),ANCUV(NN+9)
    6 CDNTINUE
      J = IRDT/1D
      ANCUV(IROT+1) = CFMD(IRDT)
      WRITE (6,5) J,ANCUV(IRDT+1)
C
C     WRITE BD.FT. PER ACRE FDR EACH YEAR
C
      WRITE (6,7)
    7 FDRMAT (1HD,///,55X,23HTHDUSANDS OF BDARD FEET,//)
      WRITE (6,8) K,(ANBDF(NN),NN=1,1D)
    B FDRMAT (1H ,I2D,F13.3,9F1D.3)
      DD 9 J=1,IJ
      NN = 1D * J + 1
      WRITE (6,8) J,ANBDF(NN),ANBDF(NN+1),ANBDF(NN+2),AN8DF(NN+3),ANBDF(
     1NN+4),ANBDF(NN+5),ANBDF(NN+6),ANBDF(NN+7),ANBDF(NN+B),ANBDF(NN+9)
    9 CDNTINUE
      J = IRDT/1D
      ANBDF(IROT+1) = BDFD(IROT)
      WRITE (6,B) J,ANBDF(IRDT+1)
C
C     PRDVIDE FDR ANY ACRES BEYOND CUTAGE LEFT UNTHINNED FDR A FEW YEARS
C
      JCYCL = CYCL
      IMI = JCYCL - 1
      DO 1D I=N1,IRDT,JCYCL
      DD 1D J=1,IMI
      NX = I + J
      IF (NX .GE. 18D) GD TD 11
      BDFC(NX) = BDFC(I)
   1D CFMC(NX) = CFMC(I)
   11 RETURN
      END
      SUBROUTINE INPUT2
      COMMDN ACCST,AGEO,AGMRCH,ANBOF(181),ANCUV(181),ANNET,BATCH(3),BDFC
     1(18D),BOFD(18D),BFCST,CFMC(18D),CFMO(1BD),CSTAC,CSTVL,CUCST,CUTAGE
     2,O8HO,DENO,DESCR(5),DLEV,FMRCHD(1D),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(1BO),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,15D),IYEAR,
     4KOL(6),LAND,LAST,MALCUT(1D),MDLD,NACRE(1BD),NGAME,NKOLS,N1,NDNSTK,
     5NOYRS,PRET,PRIBD(15O),PRICF(15D),PRIOIV(1D),RETRN,RDTA,RATE,GRDW,
     6SITE,SUMM(6,25,1D),TCOST,SHELT,YRLDS,FINL,CLDSS,CTHN,CPLT,CFPCT,
     7VAR(14,15D),VLBF,VLCU,ACAGE(1DDO),CYCL,KOUNT,DEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,BFSALV,COMCU,COMBF,8FPCT,GNTR
C
C     SET INITIAL VALUES OF ZERD
C
      CSTAC = D.D
      CSTVL = D.D
      IALCUT = D
      KOUNT = 1
      LAST = O
      RETRN = O.D
      YRLDS = D.D
      DO 1 I=1,18D
      IACRE(I) = O
    1 NACRE(I) = D
      OO 2 I=1,1D
      FMRCHD(I) = D.D
      MALCUT(I) = O
    2 PRIDIV(I) = D.D
      OO 3 I=1,26
      DO 3 J=1,15D
    3 IVAR(I,J) = D
      OO 4 I=1,14
      DO 4 J=1,15D
    4 VAR(I,J) = O.D
C
C     READ VALUES THAT DO NOT CHANGE WITHIN A GAME
C
      READ (5,5) (GMNAM(I),I=1,3)
    5 FORMAT (3A8)
      READ (5,6) LAND,MOLO,NONSTK,KAREA,IPLNT
    6 FORMAT (2DI4)
      IF (KAREA .EQ. D) GO TD B
C
C     READ IN EQUAL AREAS IN ALL AGE CLASSES
C
      NOX = MDLD + 1
      DO 7 I=1,NDX
    7 IACRE(I) = KAREA
C
C     AOJUST NUMBER OF ACRES IN OLOEST CLASS IF TOTAL AREA NDT MULTIPLE
C     OF KAREA
C
      KOIFF = LANO - NDX * KAREA - NDNSTK
      IACRE(NDX) = IACRE(NOX) + KOIFF
      IACRE(1) = IACRE(1) + NDNSTK
      GO TD 1D
C
C     READ IN UNEQUAL AREAS IN AGE CLASSES
C
    8 REAO (5,9) (IACRE(I),I=1,18D)
    9 FDRMAT (15I4)
C
C     READ LIMITATIONS ON CUT
C
   1D READ (5,11) (PRIDIV(I),I=1,1D)
   11 FORMAT (1OF8.3)
```

```
      READ (5,9) (MALCUT(I),I=1,10)
      READ (5,11) (FMRCHO(I),I=1,10)
      READ (5,11) SHELT,RATE,CPLT,CTHN,CLOSS,ACCST,CUCST,BFCST,GROW,FINL
      READ (5,12) OEFOR,ANUL
   12 FORMAT (2F8.5)
      OEFOR1 = OEFOR * 100.0
C
C     PRINT CONOITIONS OF SIMULATIONS
C
      WRITE (6,13)
   13 FORMAT (1H1,//,46X,26HALTERNATIVES FOR THIS GAME)
      WRITE (6,14) (BATCH(I),I=1,3)
   14 FORMAT (1H ,45X,7HBATCH  ,3A8)
      WRITE (6,15) ITEST
   15 FORMAT (1H ,45X,4HTEST,I4)
      WRITE (6,16) (GMNAM(I),I=1,3)
   16 FORMAT (1H ,45X,6HGAME  ,3A8)
      WRITE (6,17) (OESCR(I),I=1,5)
   17 FORMAT (1H ,45X,5A8,////)
      WRITE (6,18) NOYRS
   18 FORMAT (1H ,45X,24HNUMBER OF YEARS PER GAME,I4,////)
      WRITE (6,19) (PRIOIV(I),I=1,10)
   19 FORMAT (1H ,15HCRITICAL PRICES,12X,10F9.2)
      WRITE (6,20) (MALCUT(I),I=1,10)
   20 FORMAT (1H ,13HALLOWABLE CUT,11X,10I9)
      WRITE (6,21) (FMRCHO(I),I=1,10)
   21 FORMAT (1H ,19HMINIMUM CUTTING AGE,5X,10F9.0,////)
      WRITE (6,22) LANO
   22 FORMAT (1H ,23HACRES IN WORKING CIRCLE,13X,I4,25X,27HCOSTS IN FIRS
     1T YEAR OF GAME)
      WRITE (6,23) ACCST
   23 FORMAT (1H ,69X,17HPER ACRE (ANNUAL),8X,F9.2)
      WRITE (6,24) CUCST
   24 FORMAT (1H ,38HMINIMUM VALUES FOR INCLUSION IN TOTALS,31X,25HPER 1
     100 CU. FT. HARVESTEO,F9.2)
      WRITE (6,25) AGMRCH,BFCST
   25 FORMAT (1H ,4X,22HAGE, FOR GROWING STOCK,11X,F3.0,29X,13HPER M BO.
     1 FT.,12X,F9.2)
      WRITE (6,26) BFMRCH,CTHN
   26 FORMAT (1H ,4X,28HM BO. FT., FOR GROWING STOCK,5X,F5.1,27X,13HTHIN
     1 ONE ACRE,12X,F9.2)
      WRITE (6,27) COMCU,CPLT
   27 FORMAT (1H ,4X,27HCU. FT., FOR COMMERCIAL CUT,5X,F4.0,29X,14HPLANT
     1 ONE ACRE,11X,F9.2)
      WRITE (6,28) COMBF,CLOSS
   28 FORMAT (1H ,4X,29HM BO. FT., FOR COMMERCIAL CUT,4X,F5.1,27X,19HCLE
     1ANUP OF ONE ACRE,6X,F9.2)
      WRITE (6,29) BFSALV,RATE
   29 FORMAT (1H ,4X,22HM BO. FT., FOR SALVAGE,11X,F5.1,23X,25HRATE OF I
     1NCREASE IN COSTS,4X,F9.2,//)
      WRITE (6,30) IPLNT
   30 FORMAT (1H ,22HACRES PLANTEO ANNUALLY,14X,I4,25X,35HRELATIVE VALUE
     1 OF INTERMEOIATE CUTS)
      WRITE (6,31) OEFOR1,CFPCT
   31 FORMAT (1H ,30HPERCENT OF ACRES LOST ANNUALLY,6X,F8.3,25X,23HSTUMP
     1AGE PRICE, CU. FT.,2X,F9.2)
      WRITE (6,32) SHELT,BFPCT
   32 FORMAT (1H ,24HM BO. FT. IN SHELTERWOOO,13X,F5.1,27X,23HSTUMPAGE P
     1RICE, 80. FT.,2X,F9.2)
      WRITE (6,33) FINL
   33 FORMAT (1H ,19HREGENERATION PERIOO,18X,F5.1,//)
      WRITE (6,34) ANUL
   34 FORMAT (1H ,29HPSEUOORANOOM NUMBER GENERATOR,5X,F8.1)
      WRITE (6,35) GNTR
   35 FORMAT (1H ,34X,F8.1)
      RETURN
      ENO
      SUBROUTINE AREAS
      COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,BATCH(3),8OFC
     1(180),8OFO(180),BFCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,OBHO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVALB,GSVALC,GVLBF,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRIBO(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VLBF,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,BFSALV,COMCU,COMBF,BFPCT,GNTR
      GSVALB = 0.0
      GSVALC = 0.0
      GVLBF = 0.0
      GVLCU = 0.0
      OO 1 I=1,18
    1 ISUM(I) = 0
      OO 2 I=1,1000
    2 ACAGE(I) = 0.0
C
C     CONVERT ACRES IN EACH IACRE(I) TO INOIVIOUAL ACRES
C
      JK = 0
      DO 30 J=1,180
      IF (JK .GE. LANO) GO TO 4
      IF (IACRE(J) .LE. 0) GO TO 30
      KL = JK + 1
      JK = JK + IACRE(J)
      OO 3 I=KL,JK
      NAC = LANO + 1 - I
      ACAGE(NAC) = J - 1
    3 CONTINUE
   30 CONTINUE
C
C     GET OISTRIBUTION OF ACRES BY AGE.
C     CHECK THAT NO ACRE IS OLOER THAN 179 YEARS
C
    4 OO 7 K=1,LANO
      IF (ACAGE(K) .LE. 179.0) GO TO 6
      WRITE (6,5)
    5 FORMAT (1H1,47X,38HYOU WENT BEYONO AGE LIMIT OF 179 YEARS)
      IYEAR = NOYRS - 1
      RETURN
    6 LM = ACAGE(K) + 1.0
    7 NACRE(LM) = NACRE(LM) + 1
C
C     COMPUTE TOTAL ACREAGE BY 10-YEAR AGE CLASSES
C
      OO 8 I=1,18
      OO 8 J=1,10
      NS = 10 * (I - 1) + J
    8 ISUM(I) = ISUM(I) + NACRE(NS)
C
C     COMPUTE GROWING STOCK VOLUME.
C     USE CU.FT. IF VOLUME IS LESS THAN BFMRCH
C
      OO 10 M=1,LANO
      IF (ACAGE(M) .LT. AGMRCH) GO TO 10
      IAG = ACAGE(M) + 1.0
      IF (AN8OF(IAG) .GE. BFMRCH) GO TO 9
      GVLCU = GVLCU + ANCUV(IAG)
      GO TO 10
    9 GVLBF = GVL8F + AN8OF(IAG)
   10 CONTINUE
C
C     COMPUTE INITIAL NON-ZERO VALUES FOR OUTPUT2
C
      IVAR(7,1) = GVLCU + 0.5
      IVAR(8,1) = GVLBF + 0.5
      IVAR(9,1) = IVAR(5,1) + IVAR(7,1)
      IVAR(10,1) = IVAR(6,1) + IVAR(8,1)
      IVAR(11,1) = NONSTK
      VAR(1,1) = PRICF(1)
      VAR(2,1) = PRI80(1)
      GSVALB = GVLBF * (PRI80(1) - BFCST)
      GSVALC = (GVLCU/100.0) * (PRICF(1) - CUCST)
      VAR(13,1) = GSVALC + GSVALB
      VAR(14,1) = VAR(13,1) + VAR(12,1)
      OO 11 I=1,14
      N = I + 11
   11 IVAR(N,1) = ISUM(I)
      IVAR(26,1) = ISUM(15) + ISUM(16) + ISUM(17) + ISUM(18)
C
C     WRITE HEAOINGS FOR TABLE OF INITIAL OISTRIBUTION OF ACRES BY AGE
C
      WRITE (6,12)
   12 FORMAT (1H1,////,38X,36HINITIAL OISTRIBUTION OF ACRES BY AGE)
      WRITE (6,13) (BATCH(I),I=1,3)
   13 FORMAT (1H ,45X,7HBATCH  ,3A8)
      WRITE (6,14) ITEST
   14 FORMAT (1H ,45X,4HTEST,I4)
      WRITE (6,15) (GMNAM(I),I=1,3)
   15 FORMAT (1H ,45X,6HGAME  ,3A8)
      WRITE (6,16) (DESCR(I),I=1,5)
   16 FORMAT (1H ,45X,5A8)
      WRITE (6,17)
   17 FORMAT (1H ,45X,16HYEAR WITHIN GAME,3X,1H0,///)
      WRITE (6,18)
   18 FORMAT (1H ,55X,9HAGE(YEAR))
      WRITE (6,19)
   19 FORMAT (1H ,4X,11HAGE(OECAOE),7X,1H0,7X,1H1,7X,1H2,7X,1H3,7X,1H4,7
     1X,1H5,7X,1H6,7X,1H7,7X,1H8,7X,1H9,10X,5HTOTAL,//)
C
C     WRITE NUMBER OF ACRES IN EACH 1-YEAR AGE CLASS ANO TOTALS OF
C     10-YEAR CLASSES
C
      DO 21 J=1,18
      IK = J - 1
      NN = 10 * IK + 1
      WRITE (6,20) IK,NACRE(NN),NACRE(NN+1),NACRE(NN+2),NACRE(NN+3),NACR
     1E(NN+4),NACRE(NN+5),NACRE(NN+6),NACRE(NN+7),NACRE(NN+8),NACRE(NN+9
     2),ISUM(J)
   20 FORMAT (1H ,I11,5X,10I8,I15,/)
   21 CONTINUE
      RETURN
      ENO
      SUBROUTINE YEARS
      COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,BATCH(3),8OFC
     1(180),BOFO(180),BFCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,OBHO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVAL8,GSVALC,GVLBF,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRIBO(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VLBF,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,BFMRCH,8FSALV,COMCU,COM8F,8FPCT,GNTR
      GVL8F = 0.0
      GVLCU = 0.0
      LOSS = 0
      NPLNT = 0
      RETHV = 0.0
      RETTH = 0.0
      SCLOSS = 0.0
      SCPLT = 0.0
      SCTHN = 0.0
      VLBF = 0.0
      VLCU = 0.0
      JCYCL = CYCL
      IYRM = IYEAR + 1
C
C     MAKE ANY SCHEOULEO ANNUAL PLANTING
C
      IF (NONSTK .EQ. 0) GO TO 1
      NPLNT = IPLNT
      IF (NPLNT .GT. NONSTK) NPLNT = NONSTK
      NONSTK = NONSTK -NPLNT
      APLT = NPLNT
      SCPLT = APLT * CPLT
      IF (NONSTK .EQ. 0) GO TO 1
      KIM = LANO - NONSTK + 1 + LAST
```

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      IF (KIM .GT. LAND) KIM = KIM - LAND
      ICH = KIM + NONSTK - 1
C
C     AGE ZERO OF AREAS SUBROUTINE GIVES CONDITIONS AT END OF YEAR ZERO,
C     SO INCREASE AGES ONE YEAR TO START SIMULATION
C
    1 DO 2 I=1,LAND
      ACAGE(I) = ACAGE(I) + 1.0
    2 CONTINUE
      IF (NONSTK .EQ. 0) GO TO 4
C
C     SUPPRESS AGE INCREASE FOR NONSTOCKED ACRES
C
      DO 3 I=KIM,ICH
      ACAGE(I) = 0.0
    3 CONTINUE
    4 IF (DEFOR .EQ. 0.0) GO TO 15
C
C     DETERMINE AREA DEFORESTED ANNUALLY
C
      AKDX = LAND - NONSTK
      YRLOS = (AKOX * DEFOR) + YRLOS
      IF (YRLOS .LT. 1.0) GO TO 15
C
C     GENERATE PSEUDORANDOM NUMBER FOR AGE OF ACRE DESTROYED
C
    5 NDIV = (17.0 * ANUL + 3.0)/128.0
      NULL = ANUL
      NULL = (17 * NULL + 3) - 128 * NDIV
      ANUL = NULL
C
C     CHECK THAT AGE EXISTS AND IS BETWEEN ONE AND OLDEST CURRENT AGE
C
      IF (ANUL .LE. 0.0) GO TO 5
      IF (ANUL .GT. ACAGE(KOUNT)) GO TO 5
      DO 6 M=1,LAND
      KACR = M
      IF (ACAGE(M) .EQ. ANUL) GO TO 7
    6 CONTINUE
      GO TO 5
C
C     SET LOSS TO REDUCE CURRENT ALLOWABLE CUT
C
    7 LOSS = LOSS + 1
      NONSTK = NONSTK + 1
      YRLOS = YRLOS - 1.0
C
C     SALVAGE VOLUME IF NOT LESS THAN BFSALV
C     NO SALVAGE OR CLEANUP IF AGE LESS THAN AGEO.
C
      IF (NULL .LE. N1) GO TO 9
      IF (IYEAR .EQ. 1) MTHN = FMRCHO(1)
      NULL = NULL + 1
      KULL = NULL - 1
      IF (KULL .LT. MTHN) GO TO 8
      SALVB = ANBOF(NULL) + BOFC(KULL)
      IF (SALVB .LT. BFSALV) SCLOSS = SCLOSS + CLOSS
      IF (SALVB .LT. BFSALV) GO TO 9
      VLBF = VLBF + SALVB
      RETTH = RETTH + SALVB * (PRIBO(IYRM) * BFPCT)
      GO TO 9
    8 SALVB = ANBOF(NULL)
      IF (SALVB .LT. BFSALV) SCLOSS = SCLOSS + CLOSS
      IF (SALVB .LT. BFSALV) GO TO 9
      VLBF = VLBF + SALVB
      RETTH = RETTH + SALVB * (PRIBO(IYRM) * BFPCT)
C
C     RENUMBER ACRES TO PUT ACRE LOST AT END OF AGE SEQUENCE
C     WITH AGE ZERO
C
    9 IF (KACR .NE. KOUNT) GO TO 10
      LAST = LAST + 1
      KOUNT = KOUNT + 1
      ACAGE(LAST) = 0.0
      GO TO 15
   10 LUB = LAST - 1
      IF (KACR .LT. LAST) GO TO 13
      MNO = LAND - KACR
      DO 11 J=1,MNO
      JSUB = KACR + J
      ISUB = JSUB - 1
      ACAGE(ISUB) = ACAGE(JSUB)
   11 CONTINUE
      ACAGE(LAND) = ACAGE(1)
      DO 12 K=1,LUB
      KAN = K + 1
      ACAGE(K) = ACAGE(KAN)
   12 CONTINUE
      ACAGE(LAST) = 0.0
      GO TO 15
   13 DO 14 M=KACR,LUB
      MOL = M + 1
      ACAGE(M) = ACAGE(MOL)
   14 CONTINUE
      ACAGE(LAST) = 0.0
      IF (YRLOS .GE. 1.0) GO TO 5
C
C     PREPARE SUBTOTALS FOR CURRENT YEAR AND CHECK THAT NO ACRE
C     IS OLDER THAN 179 YEARS
C
   15 DO 16 K=1,180
      NACRE(K) = 0
   16 CONTINUE
      DO 19 K=1,LAND
      IF (ACAGE(K) .LE. 179.0) GO TO 18
      WRITE (6,17)
   17 FORMAT (1H1,/////,47X,38HYOU WENT BEYOND AGE LIMIT OF 179 YEARS)
      IYEAR = NOYRS
      GO TO 42
   18 LM = ACAGE(K) + 1.0
      NACRE(LM) = NACRE(LM) + 1
   19 CONTINUE
C
C     DETERMINE ALLOWABLE CUT BASED ON BD.FT. STUMPAGE PRICE
C
      DO 20 J=1,10
      NSUB = J
      IF (PRIBO(IYRM) .LE. PRIDIV(J)) GO TO 21
   20 CONTINUE
   21 IALCUT = MALCUT(NSUB) - LOSS
      CUTAGE = FMRCHO(NSUB)
C
C     COMPUTE THINNINGS FOR ANNUAL CUT
C
      MXY = 0
      MAC = CUTAGE
      DO 24 I=N1,MAC,JCYCL
      VBTH = 0.0
      VCTH = 0.0
      IF (I .GE. MAC) GO TO 25
      MR = I + 1
      IF (BOFC(I) .LT. COMBF) GO TO 22
      VLBF1 = NACRE(MR) * BOFC(I)
      VLBF = VLBF + VLBF1
      VBTH = VLBF1
      RETTH = RETTH + VBTH * (PRIBO(IYRM) * BFPCT)
      MXY = MXY + 1
      GO TO 24
   22 IF (CFMC(I) .LT. COMCU) GO TO 23
      VLCU1 = NACRE(MR) * CFMC(I)
      VLCU = VLCU + VLCU1
      VCTH = VLCU1
      RETTH = RETTH + VCTH/100.0 * (PRICF(IYRM) * CFPCT)
      MXY = MXY + 1
      GO TO 24
   23 MXY = MXY + 1
      SCTHN = NACRE(MR) * CTHN + SCTHN
   24 CONTINUE
   25 MTHN = N1 + MXY * JCYCL
      IF (IALCUT .LE. 0) GO TO 33
C
C     COMPUTE VOLUME OF ACRES HARVESTED
C
      KYR = IYEAR + 1 + FINL
      SHWO = SHELT + (SHELT * GROW)
      ISHWO = SHWO + 0.5
      DO 32 I=1,IALCUT
      VBHV = 0.0
      VCHV = 0.0
      IF (LAST .LT. LAND) GO TO 26
      LAST = 0
   26 LAST = LAST + 1
      IF (ACAGE(LAST) .GE. CUTAGE) GO TO 27
      LAST = LAST - 1
      GO TO 33
   27 M = ACAGE(LAST)
      K = M + 1
      KOUNT = KOUNT + 1
      ISAFE = LAND + 1
      IF (KOUNT .GE. ISAFE) KOUNT = 1
      IF (M .LT. MTHN) GO TO 28
      VLBF2 = ANBOF(K) + BOFC(M) - SHELT
      IF (VLBF2 .LT. COMBF) GO TO 29
      VLBF = VLBF + VLBF2
      VBHV = VLBF2
      RETHV = RETHV + VBHV * PRIBO(IYRM)
      IVAR(4,KYR) = IVAR(4,KYR) + ISHWO
      VAR(3,KYR) = VAR(3,KYR) + (SHWD * PRIBO(KYR))
      VAR(7,KYR) = VAR(7,KYR) + SHWO * (BFCST + BFCST * RATE * FINL)
      GO TO 31
   28 VLBF2 = ANBOF(K) - SHELT
      IF (VLBF2 .LT. COMBF) GO TO 29
      VLBF = VLBF + VLBF2
      VBHV = VLBF2
      RETHV = RETHV + VBHV * PRIBO(IYRM)
      IVAR(4,KYR) = IVAR(4,KYR) + ISHWO
      VAR(3,KYR) = VAR(3,KYR) + (SHWO * PRIBO(KYR))
      VAR(7,KYR) = VAR(7,KYR) + SHWO * (BFCST + BFCST * RATE * FINL)
      GO TO 31
   29 IF (M .LT. MTHN) GO TO 30
      VLCU2 = ANCUV(K) + CFMC(M)
      IF (VLCU2 .LT. COMCU) GO TO 32
      VLCU = VLCU + VLCU2
      VCHV = VLCU2
      RETHV = RETHV + VCHV/100.0 * PRICF(IYRM)
      GO TO 31
   30 VLCU2 = ANCUV(K)
      IF (VLCU2 .LT. COMCU) GO TO 32
      VLCU = VLCU + VLCU2
      VCHV = VLCU2
      RETHV = RETHV + VCHV/100.0 * PRICF(IYRM)
   31 ACAGE(LAST) = 0.0
   32 CONTINUE
C
C     COMPUTE GROWING STOCK VOLUME. USE CU.FT. IF VOLUME IS LESS
C     THAN BFMRCH MBF
C
   33 DO 37 I=1,LAND
      IF (ACAGE(I) .LT. AGMRCH) GO TO 37
      IAG = ACAGE(I) + 1.0
      IBG = IAG - 1
      IF (IBG .LT. MTHN) GO TO 34
      GBL1 = ANBOF(IAG) + BOFC(IBG)
      IF (GBL1 .LT. BFMRCH) GO TO 35
      GVLBF = GVLBF + GBL1
      GO TO 37
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   34 G8L1 = AN8OF(IAG)
      IF (G8L1 .LT. 8FMRCH) GO TO 35
      GVL8F = GVL8F + G8L1
      GO TO 37
   35 IF (I8G .LT. MTHN) GO TO 36
      GCL1 = ANCUV(IAG) + CFMC(I8G)
      GVLCU = GVLCU + GCL1
      GO TO 37
   36 GCL1 = ANCUV(IAG)
      GVLCU = GVLCU + GCL1
   37 CONTINUE
C
C     PREPARE FOR NEW TOTALS ANO SU8TOTALS
C
      OO 38 K=1,180
   38 NACRE(K) = 0
      OO 39 I=1,18
   39 ISUM(I) = 0
      OO 40 K=1,LANO
      LM = ACAGE(K) + 1.0
      NACRE(LM) = NACRE(LM) + 1
   40 CONTINUE
C
C     COMPUTE TOTAL ACREAGE 8Y 10-YEAR AGE CLASSES
C
      OO 41 I=1,18
      OO 41 J=1,10
      NS = 10 * (I - 1) + J
      ISUM(I) = ISUM(I) + NACRE(NS)
   41 CONTINUE
C
C     COMPUTE VOLUMES AND VALUES AT ENO OF CURRENT YEAR FOR TRANSFER
C     TO ANUAL
C
   42 RETRN = RETTH + RETHV
      CSTAC = LANO * ACCST + SCPLT + SCTHN + SCLOSS
      CSTVL = CUCST * (VLCU/100.0) + 8FCST * VL8F
      TCOST = CSTAC + CSTVL
      ANNET = RETRN - TCOST
      GSVAL8 = GVL8F * (PRI8O(IYRM) - 8FCST)
      GSVALC = (GVLCU/100.0) * (PRICF(IYRM) - CUCST)
C
C     INCREASE COSTS ANNUALLY, IF OESIREO
C
      ACCST = ACCST + (ACCST * RATE)
      8FCST = 8FCST + (8FCST * RATE)
      CLOSS = CLOSS + (CLOSS * RATE)
      CPLT = CPLT + (CPLT * RATE)
      CTHN = CTHN + (CTHN * RATE)
      CUCST = CUCST + (CUCST * RATE)
      RETURN
      ENO
      SU8ROUTINE OUTPUT1
      COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,8ATCH(3),8OFC
     1(180),8OFO(180),8FCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,O8HO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVAL8,GSVALC,GVL8F,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRI8O(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VL8F,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,8FMRCH,8FSALV,COMCU,COM8F,8FPCT,GNTR
C
C     WRITE TA8LE HEADINGS
C
      WRITE (6,1)
    1 FORMAT (1H1,////,46X,28HOISTRI8UTION OF ACRES 8Y AGE)
      WRITE (6,2) (8ATCH(I),I=1,3)
    2 FORMAT (1H ,45X,7H8ATCH   ,3A8)
      WRITE (6,3) ITEST
    3 FORMAT (1H ,45X,4HTEST,I4)
      WRITE (6,4) (GMNAM(I),I=1,3)
    4 FORMAT (1H ,45X,6HGAME   ,3A8)
      WRITE (6,5) (OESCR(I),I=1,5)
    5 FORMAT (1H ,45X,5A8)
      WRITE (6,6) IYEAR
    6 FORMAT (1H ,45X,16HYEAR WITHIN GAME,I6,//)
      WRITE (6,7)
    7 FORMAT (1H ,55X,9HAGE(YEAR))
      WRITE (6,8)
    8 FORMAT (1H ,4X,11HAGE(OECAOE),7X,1HO,7X,1H1,7X,1H2,7X,1H3,7X,1H4,7
     1X,1H5,7X,1H6,7X,1H7,7X,1H8,7X,1H9,10X,5HTOTAL,//)
C
C     WRITE NUM8ER OF ACRES IN EACH 1-YEAR AGE CLASS ANO TOTALS OF
C     10-YEAR CLASSES
C
      OO 10 J=1,18
      K = J - 1
      NN = 10 * K + 1
      WRITE (6,9) K,NACRE(NN),NACRE(NN+1),NACRE(NN+2),NACRE(NN+3),NACRE(
     1NN+4),NACRE(NN+5),NACRE(NN+6),NACRE(NN+7),NACRE(NN+8),NACRE(NN+9),
     2ISUM(J)
    9 FORMAT (1H ,I11,5X,10I8,I15,/)
   10 CONTINUE
      RETURN
      ENO
      SU8ROUTINE ANUAL
      COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,8ATCH(3),8OFC
     1(180),8DFO(180),8FCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,O8HO,DENO,OESCR(5),DLEV,FMRCHO(10),GMNAM(3),GSVAL8,GSVALC,GVL8F,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LANO,LAST,MALCUT(10),MOLD,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRI8O(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VL8F,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,8FMRCH,8FSALV,COMCU,COM8F,8FPCT,GNTR
C
C     CONVERT VOLUME ANO AREA VALUES TO SU8SCRIPTED VALUES FOR USE 8Y
C     REMAINING SU8ROUTINES
C
      K = IYEAR
      J = IYEAR + 1
      IVAR(1,J) = IALCUT
      IVAR(2,J) = CUTAGE
      IVAR(3,J) = VLCU + 0.5
      I8FT = VL8F + 0.5
      IVAR(4,J) = IVAR(4,J) + I8FT
      IVAR(5,J) = IVAR(5,K) + IVAR(3,J)
      IVAR(6,J) = IVAR(6,K) + IVAR(4,J)
      IVAR(7,J) = GVLCU + 0.5
      IVAR(8,J) = GVL8F + 0.5
      IVAR(9,J) = IVAR(5,J) + IVAR(7,J)
      IVAR(10,J) = IVAR(6,J) + IVAR(8,J)
      IVAR(11,J) = NONSTK
      OO 1 I=1,14
      N = I + 11
    1 IVAR(N,J) = ISUM(I)
      IVAR(26,J) = ISUM(15) + ISUM(16) + ISUM(17) + ISUM(18)
C
C     ENTER MONEY VALUES IN ARRAYS FOR REMAINING SU8ROUTINES
C
      VAR(1,J) = PRICF(J)
      VAR(2,J) = PRI8D(J)
      VAR(3,J) = VAR(3,J) + RETRN
      VAR(4,J) = VAR(4,K) + VAR(3,J)
      VAR(5,J) = CSTAC
      VAR(6,J) = VAR(6,K) + VAR(5,J)
      VAR(7,J) = VAR(7,J) + CSTVL
      VAR(8,J) = VAR(8,K) + VAR(7,J)
      VAR(9,J) = TCOST
      VAR(10,J) = VAR(10,K) + VAR(9,J)
      VAR(11,J) = ANNET
      VAR(12,J) = VAR(12,K) + VAR(11,J)
      VAR(13,J) = GSVALC + GSVALB
      VAR(14,J) = VAR(12,J) + VAR(13,J)
      RETURN
      ENO
      SUBROUTINE OUTPUT2
      COMMON ACCST,AGEO,AGMRCH,ANBOF(181),ANCUV(181),ANNET,8ATCH(3),8OFC
     1(180),8OFO(180),8FCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
     2,O8HO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVAL8,GSVALC,GVL8F,
     3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
     4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
     5NOYRS,PRET,PRI8O(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
     6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
     7VAR(14,150),VL8F,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
     8RINT,THIN,8FMRCH,8FSALV,COMCU,COM8F,8FPCT,GNTR
C
C     PRINT FIRST PAGE
C
      N = NOYRS + 1
      M = 40
    1 OO 15 J=1,N
      LINE = J - 1
    2 IF (M .LT. 40) GO TO 11
      M = 0
      WRITE (6,3) (8ATCH(I),I=1,3)
    3 FORMAT (1H1,//,46X,7H8ATCH   ,3A8)
      WRITE (6,4) ITEST
    4 FORMAT (1H ,45X,4HTEST,I4)
      WRITE (6,5) (GMNAM(I),I=1,3)
    5 FORMAT (1H ,45X,6HGAME   ,3A8)
      WRITE (6,6) (OESCR(I),I=1,5)
    6 FORMAT (1H ,45X,5A8)
      WRITE (6,7)
    7 FORMAT (1H ,/)
      WRITE (6,8)
    8 FORMAT (1H ,12X,9HALLOWA8LE,5X,7HCUTTING,8X,10HACTUAL CUT,10X,9HCU
     1MUL CUT,10X,9HGRSTK VOL,12X,9HTOTAL VOL)
      WRITE (6,9)
    9 FORMAT (1H ,2X,4HYEAR,9X,3HCUT,10X,3HAGE,7X,6HCU.FT.,5X,3HM8F,6X,6
     1HCU.FT.,5X,3HM8F,6X,6HCU.FT.,5X,3HM8F,6X,6HCU.FT.,5X,3HM8F)
      WRITE (6,10)
   10 FORMAT (1H ,15X,3H(1),10X,3H(2),8X,3H(3),7X,3H(4),7X,3H(5),7X,3H(6
     1),7X,3H(7),7X,3H(8),7X,3H(9),6X,4H(10),//)
   11 WRITE (6,12) LINE,(IVAR(I,J),I=1,10)
   12 FORMAT (1H ,I6,I12,I13,I12,I9,3(I11,I9))
      IF (J .LE. 1) GO TO 13
      M = M + 1
      IF (LL .LT. 10) GO TO 14
   13 WRITE (6,7)
      LL = 0
   14 LL = LL + 1
   15 CONTINUE
C
C     PRINT SECOND PAGE
C
      M = 40
      DO 23 J=1,N
      LINE = J - 1
      IF (M .LT. 40) GO TO 19
      M = 0
      WRITE (6,3) (8ATCH(I),I=1,3)
      WRITE (6,4) ITEST
      WRITE (6,5) (GMNAM(I),I=1,3)
      WRITE (6,6) (OESCR(I),I=1,5)
      WRITE (6,7)
      WRITE (6,16)
   16 FORMAT (1H ,11X,3HNON,46X,11HAGE CLASSES)
      WRITE (6,17)
   17 FORMAT (1H ,2X,4HYEAR,5X,3HSTK,114H   0-9  10-19  20-29  30-39  40
     1-49  50-59  60-69  70-79  80-89  90-99  100-109  110-119  120-129
     2 130-139  140-179)
      WRITE (6,18)
   18 FORMAT (1H ,10X,117H(11)   (12)   (13)   (14)   (15)   (16)   (17)
     I  (18)   (19)   (20)   (21)    (22)    (23)    (24)    (25)
```

```
     2 (26),//)
  19 WRITE (6,20) LINE,(IVAR(I,J),I=11,26)
  20 FORMAT (1H ,I6,2I7,I6,8I7,I8,4I9)
     IF (J .LE. 1) GO TO 21
     M = M + 1
     IF (LL .LT. 10) GO TO 22
  21 WRITE (6,7)
     LL = 0
  22 LL = LL + 1
  23 CONTINUE
C
C    PRINT THIRO PAGE
C
     M = 40
     DO 31 J=1,N
     LINE = J - 1
     IF (M .LT. 40) GO TO 27
     M = 0
     WRITE (6,3) (BATCH(I),I=1,3)
     WRITE (6,4) ITEST
     WRITE (6,5) (GMNAM(I),I=1,3)
     WRITE (6,6) (OESCR(I),I=1,5)
     WRITE (6,7)
     WRITE (6,24)
  24 FORMAT (1H ,18X,14HSTUMPAGE PRICE,9X,15HSTUMPAGE INCOME,13X,10HARE
    1A COSTS,15X,12HVOLUME COSTS)
     WRITE (6,25)
  25 FORMAT (1H ,2X,4HYEAR,9X,10H100 CU.FT.,5X,3HM8F,6X,6HANNUAL,5X,9HC
    1UMULATEO,6X,6HANNUAL,5X,9HCUMULATED,6X,6HANNUAL,5X,9HCUMULATEO)
     WRITE (6,26)
  26 FORMAT (1H ,18X,4H(27),8X,4H(28),6X,4H(29),9X,4H(30),9X,4H(31),9X,
    14H(32),9X,4H(33),9X,4H(34),//)
  27 WRITE (6,28) LINE,(VAR(I,J),I=1,8)
  28 FORMAT (1H ,I6,F16.2,F11.2,F12.0,F11.0,2(F15.0,F11.0))
     IF (J .LE. 1) GO TO 29
     M = M + 1
     IF (LL .LT. 10) GO TO 30
  29 WRITE (6,7)
     LL = 0
  30 LL = LL + 1
  31 CONTINUE
C
C    PRINT FOURTH PAGE
C
     M = 40
     DO 39 J=1,N
     LINE = J - 1
     IF (M .LT. 40) GO TO 35
     M = 0
     WRITE (6,3) (BATCH(I),I=1,3)
     WRITE (6,4) ITEST
     WRITE (6,5) (GMNAM(I),I=1,3)
     WRITE (6,6) (OESCR(I),I=1,5)
     WRITE (6,7)
     WRITE (6,32)
  32 FORMAT (1H ,18X,10HTOTAL COST,17X,10HNET INCOME,13X,13HCURRENT VAL
    1UE,9X,5HTOTAL)
     WRITE (6,33)
  33 FORMAT (1H ,2X,4HYEAR,8X,6HANNUAL,5X,9HCUMULATEO,7X,6HANNUAL,5X,9H
    1CUMULATED,7X,13HGROWING STOCK,7X,9HNET WORTH)
     WRITE (6,34)
  34 FORMAT (1H ,15X,4H(35),9X,4H(36),10X,4H(37),9X,4H(38),13X,4H(39),1
    14X,4H(40),//)
  35 WRITE (6,36) LINE,(VAR(I,J),I=9,14)
  36 FORMAT (1H ,I6,F14.0,F12.0,F15.0,F12.0,2F18.0)
     IF (J .LE. 1) GO TO 37
     M = M + 1
     IF (LL .LT. 10) GO TO 38
  37 WRITE (6,7)
     LL = 0
  38 LL = LL + 1
  39 CONTINUE
     RETURN
     END
     SUBROUTINE WORTH
     COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,8ATCH(3),BOFC
    1(180),8OFO(180),8FCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
    2,OBHO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVALB,GSVALC,GVL8F,
    3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
    4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
    5NOYRS,PRET,PRI8O(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
    6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
    7VAR(14,150),VL8F,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
    8RINT,THIN,8FMRCH,BFSALV,COMCU,COM8F,8FPCT,GNTR
     OIMENSION CRATE(20),OISC(20),OISG(20),OISI(20),PREV(20),PWTH(20),R
    1ATIO(20,150)
     DO 1 I=1,20
     CRATE(I) = 0.0
     OISC(I) = 0.0
     OISG(I) = 0.0
     OISI(I) = 0.0
     PREV(I) = 0.0
   1 PWTH(I) = 0.0
     DO 2 I=1,20
     DO 2 J=1,150
   2 RATIO(I,J) = 0.0
C
C    PREPARE ARRAY OF ALTERNATIVE RATES
C
     CRATE(1) = 0.010
     DO 3 I=1,19
     K = I + 1
   3 CRATE(K) = CRATE(I) + 0.005
C
C    PREPARE INTEREST TABLE FOR PERIOO NOYRS
C
     DO 4 J=1,20
     FACTR = 1.0 + CRATE(J)
```

```
     DO 4 K=1,NOYRS
     YRS = K
     PROD = ALOG(FACTR) * YRS
     RATIO(J,K) = EXP(PROO)
   4 CONTINUE
C
C    OISCOUNT GROWING STOCK VALUE AT NOYRS
C
     DO 5 L=1,20
     KL = NOYRS + 1
     OISG(L) = VAR(13,KL)/RATIO(L,NOYRS)
   5 CONTINUE
C
C    OISCOUNT ANNUAL COSTS AND RETURNS
C
     DO 7 M=1,20
     PRESC = 0.0
     PRESI = 0.0
     SPRSC = 0.0
     SPRSI = 0.0
     DO 6 N=1,NOYRS
     I = N + 1
     PRESC = VAR(9,I)/RATIO(M,N)
     PRESI = VAR(3,I)/RATIO(M,N)
     SPRSC = SPRSC + PRESC
     SPRSI = SPRSI + PRESI
   6 CONTINUE
     OISI(M) = SPRSI
     OISC(M) = SPRSC
   7 CONTINUE
C
C    O8TAIN PRESENT WORTH AT EACH RATE
C
     DO 8 IJ=1,20
     PREV(IJ) = OISI(IJ) + OISG(IJ)
     PWTH(IJ) = PREV(IJ) - OISC(IJ) - VAR(13,1)
     CRATE(IJ) = CRATE(IJ) * 100.0
   8 CONTINUE
     WRITE (6,9)
   9 FORMAT (1H1,////,53X,29HPRESENT WORTH AND RATE EARNEO)
     WRITE (6,10) (8ATCH(I),I=1,3)
  10 FORMAT (1H ,52X,7H8ATCH  ,3A8)
     WRITE (6,11) ITEST
  11 FORMAT (1H ,52X,4HTEST,I4)
     WRITE (6,12) (GMNAM(I),I=1,3)
  12 FORMAT (1H ,52X,6HGAME  ,3A8)
     WRITE (6,13) (OESCR(I),I=1,5)
  13 FORMAT (1H ,52X,5A8)
     WRITE (6,14) NOYRS
  14 FORMAT (1H ,52X,15HYEARS IN PERIOO,I5,//)
     WRITE (6,15) VAR(13,1)
  15 FORMAT (1H ,11X,33HVALUE OF INITIAL GROWING STOCK--$,F10.2,//)
     WRITE (6,16)
  16 FORMAT (1H ,57X,38HVALUES OISCOUNTEO TO PRESENT (OOLLARS),/)
     WRITE (6,17)
  17 FORMAT (1H ,11X,8HCOMPOUNO,15X,6HFUTURE,34X,5HSTOCK,36X,3HNET)
     WRITE (6,18)
  18 FORMAT (1H ,13X,4HRATE,16X,7HGROWING,15X,3HALL,17X,4HPLUS,16X,3HAL
    1L,15X,7HPRESENT)
     WRITE (6,19)
  19 FORMAT (1H ,11X,9H(PERCENT),14X,5HSTOCK,14X,7HINCOMES,13X,7HINCOME
    1S,14X,5HCOSTS,15X,5HWORTH,/)
     DO 21 I=1,20
     WRITE (6,20)CRATE(I),OISG(I),OISI(I),PREV(I),OISC(I),PWTH(I)
  20 FORMAT (1H ,12X,F5.1,12X,5(F10.2,10X),/)
  21 CONTINUE
     RETURN
     END
     SU8ROUTINE SUMRY
     COMMON ACCST,AGEO,AGMRCH,AN8OF(181),ANCUV(181),ANNET,BATCH(3),8OFC
    1(180),8OFO(180),BFCST,CFMC(180),CFMO(180),CSTAC,CSTVL,CUCST,CUTAGE
    2,OBHO,OENO,OESCR(5),OLEV,FMRCHO(10),GMNAM(3),GSVAL8,GSVALC,GVL8F,
    3GVLCU,IACRE(180),IALCUT,IGAME,ISUM(18),ITEST,IVAR(26,150),IYEAR,
    4KOL(6),LANO,LAST,MALCUT(10),MOLO,NACRE(180),NGAME,NKOLS,N1,NONSTK,
    5NOYRS,PRET,PRI8O(150),PRICF(150),PRIOIV(10),RETRN,ROTA,RATE,GROW,
    6SITE,SUMM(6,25,10),TCOST,SHELT,YRLOS,FINL,CLOSS,CTHN,CPLT,CFPCT,
    7VAR(14,150),VL8F,VLCU,ACAGE(1000),CYCL,KOUNT,OEFOR,ANUL,MIX,IPLNT,
    8RINT,THIN,8FMRCH,8FSALV,COMCU,COMBF,BFPCT,GNTR
C
C    CONVERT IVAR(I,J) AND VAR(I,J) TO SUMM(I,J,K) AT ENO OF EACH GAME
C
     LIM = 10 + NOYRS/10
     DO 4 I=1,NKOLS
     DO 4 J=1,LIM
     K = KOL(I)
     IF (J .GT. 10) GO TO 1
     JJ = J + 1
     GO TO 2
   1 JJ = 10 * (J - 10) + 1
   2 IF (K .GT. 26) GO TO 3
     SUMM(I,J,IGAME) = IVAR(K,JJ)
     GO TO 4
   3 K = K - 26
     SUMM(I,J,IGAME) = VAR(K,JJ)
   4 CONTINUE
C
C    WRITE SUMMARY TA8LES IF ALL GAMES FINISHEO
C
     IF (IGAME .LT. NGAME) GO TO 17
C
C    WRITE PAGE HEAOINGS. SEPARATE PAGE FOR EACH COLUMN OF OUTPUT2
C    IOENTIFIEO IN INPUT1
C
     DO 16 I=1,NKOLS
     WRITE (6,5)
   5 FORMAT (1H1,////,46X,26HCOMPARISON OF ALTERNATIVES)
     WRITE (6,6) (8ATCH(I),I=1,3)
   6 FORMAT (1H ,45X,7HBATCH  ,3A8)
```

```
      WRITE (6,7) ITEST
    7 FORMAT (1H ,45X,4HTEST,I4)
      WRITE (6,8) (DESCR(I),I=1,5)
    8 FORMAT (1H ,45X,5A8)
      K = KOL(I)
      WRITE (6,9) K
    9 FORMAT (1H ,45X,8HCOLUMN  ,I3,///)
      WRITE (6,10)
   10 FORMAT (1H ,5X,4HYEAR,6X,6HGAME 1,6X,6HGAME 2,6X,6HGAME 3,6X,6HGAM
     1E 4,6X,6HGAME 5,6X,6HGAME 6,6X,6HGAME 7,6X,6HGAME 8,6X,6HGAME 9,6X
     2,7HGAME 10,//)
      M = 0
C
C     WRITE SUMM(I,J,K) FOR EACH OF FIRST 10 YEARS AND FOR END OF
C     EACH DECADE
C
      DO 16 J=1,25
      IF (J .GT. 10) GO TO 11
      JJ = J
      GO TO 12
   11 JJ = 10 * (J - 10)
   12 IF (M .LT. 5) GO TO 14
      WRITE (6,13)
   13 FORMAT (1H ,//)
      M = 0
   14 WRITE (6,15) JJ,(SUMM(I,J,L),L=1,10)
   15 FORMAT (1H ,I9,F11.0,9F12.0)
   16 M = M+1
   17 RETURN
      END
```

APPENDIX 2

Output of Test Problem

PAGE TYPE 1

YIELDS PER ACRE OF MANAGED, EVEN-AGED STANDS OF PONDEROSA PINE IN THE BLACK HILLS
SITE INDEX 60, 20-YEAR CUTTING CYCLE, DENSITY LEVEL 100

ENTIRE STAND BEFORE AND AFTER THINNING								PERIODIC CUT AND MORTALITY				
STAND AGE (YEARS)	TREES NO.	BASAL AREA SQ.FT.	AVERAGE D.B.H. IN.	AVERAGE HEIGHT FT.	TOTAL VOLUME CU.FT.	MERCHANT-ABLE VOLUME CU.FT.	SAWTIMBER VOLUME MBF	TREES NO.	BASAL AREA SQ.FT.	TOTAL VOLUME CU.FT.	MERCHANT-ABLE VOLUME CU.FT.	SAWTIMBER VOLUME MBF
30	1000	110	4.5	20	818	201	0.					
30	496	73	5.2	20	534	201	0.	504	37	284	0	0
40	496	104	6.2	28	1146	684	0.					
50	496	133	7.0	35	1866	1381	0.					
50	286	86	7.4	35	1209	954	0.	210	47	657	427	0
60	286	108	8.3	41	1806	1556	1.790					
70	286	129	9.1	47	2501	2241	3.880					
70	200	99	9.5	47	1930	1756	3.510	86	30	571	485	.370
80	200	116	10.3	52	2515	2341	5.990					
90	200	132	11.0	57	3144	2940	8.990					
90	141	100	11.4	57	2407	2255	7.560	59	32	737	685	1.430
100	141	115	12.2	60	2902	2730	10.590					
110	141	130	13.0	63	3457	3263	13.650					
110	102	100	13.4	63	2701	2555	11.020	39	30	756	708	2.630
120	102	114	14.3	66	3216	3055	13.960					
130	102	127	15.1	69	3741	3565	16.980					
130	76	100	15.5	69	2998	2863	13.910	26	27	743	702	3.070
140	76	112	16.4	71	3445	3297	16.740					
150	76	123	17.2	73	3887	3723	19.510					

PAGE TYPE 2

GROWING STOCK OF MANAGED BLACK HILLS PONDEROSA PINE
SITE INDEX 60, 20-YEAR CUTTING CYCLE
DENSITY LEVEL- 120 AND 100

VOLUMES PRESENT PER ACRE AT END OF EACH YEAR
MERCHANTABLE CUBIC FEET

	YEAR									
DECADE	0	1	2	3	4	5	6	7	8	9
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	201.0	249.3	297.6	345.9	394.2	442.5	490.8	539.1	587.4	635.7
4	684.0	753.7	823.4	893.1	962.8	1032.5	1102.2	1171.9	1241.6	1311.3
5	954.0	1014.2	1074.4	1134.6	1194.8	1255.0	1315.2	1375.4	1435.6	1495.8
6	1556.0	1624.5	1693.0	1761.5	1830.0	1898.5	1967.0	2035.5	2104.0	2172.5
7	1756.0	1814.5	1873.0	1931.5	1990.0	2048.5	2107.0	2165.5	2224.0	2282.5
8	2341.0	2400.9	2460.8	2520.7	2580.6	2640.5	2700.4	2760.3	2820.2	2880.1
9	2255.0	2302.5	2350.0	2397.5	2445.0	2492.5	2540.0	2587.5	2635.0	2682.5
10	2730.0	2783.3	2836.6	2889.9	2943.2	2996.5	3049.8	3103.1	3156.4	3209.7
11	2555.0	2605.0	2655.0	2705.0	2755.0	2805.0	2855.0	2905.0	2955.0	3005.0
12	3055.0	3106.0	3157.0	3208.0	3259.0	3310.0	3361.0	3412.0	3463.0	3514.0
13	2863.0	2906.4	2949.8	2993.2	3036.6	3080.0	3123.4	3166.8	3210.2	3253.6
14	3297.0	3339.6	3382.2	3424.8	3467.4	3510.0	3552.6	3595.2	3637.8	3680.4
15	3723.0									

PAGE TYPE 2 (continued)

THOUSANDS OF BOARD FEET

0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	.179	.358	.537	.716	.895	1.074	1.253	1.432	1.611
6	1.790	1.999	2.208	2.417	2.626	2.835	3.044	3.253	3.462	3.671
7	3.510	3.758	4.006	4.254	4.502	4.750	4.998	5.246	5.494	5.742
8	5.990	6.290	6.590	6.890	7.190	7.490	7.790	8.090	8.390	8.690
9	7.560	7.863	8.166	8.469	8.772	9.075	9.378	9.681	9.984	10.287
10	10.590	10.896	11.202	11.508	11.814	12.120	12.426	12.732	13.038	13.344
11	11.020	11.314	11.608	11.902	12.196	12.490	12.784	13.078	13.372	13.666
12	13.960	14.262	14.564	14.866	15.168	15.470	15.772	16.074	16.376	16.678
13	13.910	14.193	14.476	14.759	15.042	15.325	15.608	15.891	16.174	16.457
14	16.740	17.017	17.294	17.571	17.848	18.125	18.402	18.679	18.956	19.233
15	19.510									

PAGE TYPE 3

ALTERNATIVES FOR THIS GAME
BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGED,THINNED AGE 30

NUMBER OF YEARS PER GAME 30

CRITICAL PRICES	99.00	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALLOWABLE CUT	7	0	0	0	0	0	0	0	0	0
MINIMUM CUTTING AGE	130	0	0	0	0	0	0	0	0	0

ACRES IN WORKING CIRCLE 915

MINIMUM VALUES FOR INCLUSION IN TOTALS
AGE, FOR GROWING STOCK 40
M BD. FT., FOR GROWING STOCK 1.5
CU. FT., FOR COMMERCIAL CUT 400
M BD. FT., FOR COMMERCIAL CUT 3.0
M BD. FT., FOR SALVAGE 1.5

ACRES PLANTED ANNUALLY 1
PERCENT OF ACRES LOST ANNUALLY .040
M BD. FT. IN SHELTERWOOD 4.0
REGENERATION PERIOD 10.0

PSEUDORANDOM NUMBER GENERATOR 21.0
2222.0

COSTS IN FIRST YEAR OF GAME
PER ACRE (ANNUAL) .20
PER 100 CU. FT. HARVESTED .05
PER M BD. FT. 1.56
THIN ONE ACRE 25.00
PLANT ONE ACRE 30.00
CLEANUP OF ONE ACRE 25.00
RATE OF INCREASE IN COSTS .01

RELATIVE VALUE OF INTERMEDIATE CUTS
STUMPAGE PRICE, CU. FT. 1.00
STUMPAGE PRICE, BD. FT. .85

PAGE TYPE 4

INITIAL DISTRIBUTION OF ACRES BY AGE
BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGED,THINNED AGE 30
YEAR WITHIN GAME 0

	AGE(YEAR)										
AGE(DECADE)	0	1	2	3	4	5	6	7	8	9	TOTAL
0	12	7	7	7	7	7	7	7	7	7	75
1	7	7	7	7	7	7	7	7	7	7	70
2	7	7	7	7	7	7	7	7	7	7	70
3	7	7	7	7	7	7	7	7	7	7	70
4	7	7	7	7	7	7	7	7	7	7	70
5	7	7	7	7	7	7	7	7	7	7	70
6	7	7	7	7	7	7	7	7	7	7	70
7	7	7	7	7	7	7	7	7	7	7	70
8	7	7	7	7	7	7	7	7	7	7	70
9	7	7	7	7	7	7	7	7	7	7	70
10	7	7	7	7	7	7	7	7	7	7	70
11	7	7	7	7	7	7	7	7	7	7	70
12	7	7	7	7	7	7	7	7	7	7	70
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0

PAGE TYPE 4 (continued)

DISTRIBUTION OF ACRES BY AGE
BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGED,THINNED AGE 30
YEAR WITHIN GAME 30

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	7	7	7	7	7	7	7	7	7	7	70
1	7	7	7	7	7	7	7	7	7	7	70
2	6	7	7	7	7	8	8	7	8	8	73
3	8	7	7	7	7	7	6	7	7	7	70
4	7	7	7	7	7	7	7	7	7	7	70
5	7	6	7	7	7	7	7	7	7	7	69
6	7	7	7	7	7	7	7	7	7	5	68
7	7	7	7	7	7	7	7	7	7	7	70
8	7	7	7	7	6	7	7	7	7	7	69
9	7	7	7	7	7	7	7	7	7	7	70
10	6	7	7	7	7	7	7	7	7	7	69
11	7	7	7	7	7	7	7	6	7	7	69
12	7	7	7	7	7	7	7	7	7	7	70
13	7	1	0	0	0	0	0	0	0	0	8
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0

PAGE TYPE 5

BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGED,THINNED AGE 30

YEAR	ALLOWABLE CUT (1)	CUTTING AGE (2)	ACTUAL CUT CU.FT. (3)	MBF (4)	CUMUL CUT CU.FT. (5)	MBF (6)	GRSTK VOL CU.FT. (7)	MBF (8)	TOTAL VOL CU.FT. (9)	MBF (10)
0	0	0	0	0	0	0	145108	4439	145108	4439
1	7	130	16135	91	16135	91	145108	4439	161243	4530
2	7	130	16135	91	32270	182	145108	4439	177378	4621
3	6	130	16135	90	48405	272	145108	4444	193513	4716
4	7	130	16135	91	64540	363	145108	4444	209648	4807
5	7	130	16135	91	80675	454	145108	4443	225783	4897
6	6	130	16135	91	96810	545	145108	4447	241918	4992
7	7	130	16135	91	112945	636	145108	4447	258053	5083
8	7	130	16135	91	129080	727	145108	4446	274188	5173
9	6	130	14719	78	143799	805	145108	4468	288907	5273
10	7	130	16135	92	159934	897	145108	4467	305042	5364
11	6	130	16135	114	176069	1011	145108	4483	321177	5494
12	7	130	16135	127	192204	1138	145108	4483	337312	5621
13	7	130	16135	122	208339	1260	145108	4482	353447	5742
14	6	130	16135	114	224474	1374	145108	4499	369582	5873
15	7	130	16135	127	240609	1501	145108	4498	385717	5999
16	7	130	16135	122	256744	1623	145108	4497	401852	6120
17	6	130	16135	122	272879	1745	145108	4506	417987	6251
18	7	130	16135	128	289014	1873	145108	4505	434122	6378
19	7	130	16135	123	305149	1996	144424	4504	449573	6500
20	6	130	15450	119	320599	2115	144354	4517	464953	6632
21	7	130	16135	123	336734	2238	144284	4516	481018	6754
22	6	130	16135	128	352869	2366	144215	4519	497084	6885
23	7	130	15427	128	368296	2494	144145	4520	512441	7014
24	7	130	16135	123	384431	2617	144075	4518	528506	7135
25	6	130	16135	117	400566	2734	144006	4531	544572	7265
26	7	130	16135	128	416701	2862	143936	4530	560637	7392
27	7	130	16135	123	432836	2985	143866	4528	576702	7513
28	6	130	16135	118	448971	3103	143797	4540	592768	7643
29	7	130	15708	129	464679	3232	144154	4539	608833	7771
30	7	130	16135	124	480814	3356	144094	4537	624908	7893

BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGEO,THINNEO AGE 30

YEAR	NON STK (11)	AGE CLASSES 0-9 (12)	10-19 (13)	20-29 (14)	30-39 (15)	40-49 (16)	50-59 (17)	60-69 (18)	70-79 (19)	80-89 (20)	90-99 (21)	100-109 (22)	110-119 (23)	120-129 (24)	130-139 (25)	140-179 (26)
0	5	75	70	70	70	70	70	70	70	70	70	70	70	70	0	0
1	4	75	70	70	70	70	70	70	70	70	70	70	70	70	0	0
2	3	75	70	70	70	70	70	70	70	70	70	70	70	70	0	0
3	3	75	70	70	70	70	70	70	70	70	70	69	70	70	1	0
4	2	75	70	70	70	70	70	70	70	70	70	69	70	70	1	0
5	1	75	70	70	70	70	70	70	70	70	70	69	70	70	1	0
6	1	75	70	70	70	70	70	70	70	70	70	68	70	70	2	0
7	0	75	70	70	70	70	70	70	70	70	70	68	70	70	2	0
8	0	75	70	70	70	70	70	70	70	70	70	68	70	70	2	0
9	1	75	70	70	69	70	70	70	70	70	70	70	68	70	3	0
10	0	74	71	70	69	70	70	70	70	70	70	70	68	70	3	0
11	1	72	72	70	69	70	70	70	70	70	70	70	68	70	4	0
12	0	71	73	70	69	70	70	70	70	70	70	70	68	70	4	0
13	0	71	73	70	69	70	70	70	70	70	70	70	68	70	4	0
14	1	70	74	69	69	70	70	70	70	70	70	70	68	70	5	0
15	0	69	75	69	69	70	70	70	70	70	70	70	68	70	5	0
16	0	69	75	69	69	70	70	70	70	70	70	70	68	70	5	0
17	1	69	75	69	69	70	70	70	70	69	70	70	68	70	6	0
18	0	69	75	69	69	70	70	70	70	69	70	70	68	70	6	0
19	0	69	75	69	70	69	70	70	70	69	70	70	70	68	6	0
20	1	70	73	70	70	69	70	70	69	70	69	70	70	68	7	0
21	0	70	72	71	70	69	70	70	69	70	69	70	70	68	7	0
22	1	70	71	72	70	69	70	70	69	70	69	69	70	68	8	0
23	0	70	71	72	70	69	70	70	69	70	69	70	69	68	8	0
24	0	70	70	74	69	69	70	70	69	70	69	70	69	68	8	0
25	1	70	69	75	69	69	70	69	69	70	69	70	69	68	9	0
26	0	70	69	75	69	69	70	69	70	69	69	70	69	68	9	0
27	0	70	69	75	69	69	70	69	70	69	69	70	69	68	9	0
28	1	70	69	75	69	69	70	68	70	69	69	70	69	68	10	0
29	0	70	69	75	69	70	69	68	70	69	69	70	69	70	8	0
30	0	70	70	73	70	70	69	68	70	69	70	69	69	70	8	0

BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGEO,THINNEO AGE 30

YEAR	STUMPAGE PRICE 100 CU.FT. (27)	MBF (28)	STUMPAGE INCOME ANNUAL (29)	CUMULATEO (30)	AREA COSTS ANNUAL (31)	CUMULATEO (32)	VOLUME COSTS ANNUAL (33)	CUMULATEO (34)
0	2.50	14.50	0	0	0	0	0	0
1	2.50	15.20	1784	1784	388	388	150	150
2	2.50	17.80	2021	3805	392	780	151	301
3	2.50	16.80	1880	5686	396	1176	151	452
4	2.50	13.40	1625	7310	400	1575	155	607
5	2.50	14.10	1688	8999	404	1979	156	763
6	2.50	17.40	1952	10950	408	2387	158	921
7	2.50	11.80	1482	12433	412	2799	160	1081
8	2.50	11.10	1418	13851	384	3183	162	1242
9	2.50	12.20	1325	15176	361	3543	140	1383
10	2.50	12.90	1586	16762	424	3968	165	1548
11	2.50	10.10	1566	18329	395	4363	207	1755
12	2.50	8.30	1469	19798	433	4796	232	1987
13	2.50	9.00	1512	21310	403	5199	225	2213
14	2.50	10.90	1661	22971	407	5607	214	2427
15	2.50	13.90	2192	25163	446	6053	240	2666
16	2.50	13.10	2021	27184	416	6468	233	2899
17	2.50	11.90	1862	29046	420	6888	236	3135
18	2.50	12.70	2041	31087	460	7348	248	3382
19	2.50	15.70	2346	33433	428	7776	240	3622
20	2.50	13.60	2016	35449	433	8208	236	3859
21	2.50	12.10	1904	37353	473	8682	246	4104
22	2.50	15.20	2339	39692	441	9123	258	4363
23	2.50	16.10	2471	42163	483	9606	261	4623
24	2.50	16.70	2480	44642	419	10025	254	4877
25	2.50	19.60	2726	47368	455	10479	245	5123
26	2.50	18.50	2805	50173	498	10977	270	5392
27	2.50	14.70	2235	52408	464	11440	262	5654
28	2.50	15.50	2253	54661	468	11909	255	5909
29	2.50	17.10	2617	57278	513	12421	278	6187
30	2.50	13.00	2027	59305	511	12933	270	6458

PAGE TYPE 5 (continued)

BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGEO,THINNEO AGE 30

YEAR	TOTAL COST ANNUAL (35)	TOTAL COST CUMULATEO (36)	NET INCOME ANNUAL (37)	NET INCOME CUMULATEO (38)	CURRENT VALUE GROWING STOCK (39)	TOTAL NET WORTH (40)
0	0	0	0	0	60992	60992
1	538	538	1247	1247	64099	65346
2	543	1081	1477	2724	75570	78294
3	547	1628	1334	4058	71139	75197
4	555	2182	1070	5128	55955	61083
5	560	2742	1128	6256	58989	65246
6	565	3308	1386	7643	73641	81284
7	572	3880	910	8553	48657	57210
8	545	4425	873	9426	45464	54890
9	501	4926	824	10250	50507	60757
10	590	5516	997	11247	53551	64798
11	540	6056	659	11905	41104	53009
12	602	6658	565	12470	32952	45422
13	574	7232	657	13127	36007	49134
14	557	7789	708	13835	44593	58428
15	621	8410	1065	14900	58001	72901
16	592	9002	1020	15920	54315	70235
17	589	9591	840	16760	48919	65679
18	640	10231	939	17699	52431	70130
19	611	10841	1246	18945	65832	84777
20	600	11442	920	19865	56440	76305
21	660	12102	867	20732	49565	70296
22	630	12731	1156	21887	63512	85399
23	673	13405	1212	23099	67506	90605
24	611	14016	1347	24446	70106	94552
25	628	14644	1384	25830	83350	109180
26	695	15339	1437	27267	78246	105513
27	663	16002	1114	28380	60917	89298
28	649	16651	1039	29420	64611	94031
29	716	17367	1279	30698	71762	102461
30	717	18084	904	31603	53038	84641

PAGE TYPE 6

PRESENT WORTH ANO RATE EARNED
BATCH TEST PROBLEM
TEST 1
GAME EQUAL AREAS CUT ANNUALLY
MANAGEO,THINNEO AGE 30
YEARS IN PERIOO 30

VALUE OF INITIAL GROWING STOCK--$ 60992.01

VALUES OISCOUNTEO TO PRESENT (OOLLARS)

COMPOUNO RATE (PERCENT)	FUTURE GROWING STOCK	ALL INCOMES	STOCK PLUS INCOMES	ALL COSTS	NET PRESENT WORTH
1.0	39350.04	50396.60	89746.64	15451.27	13303.36
1.5	33931.66	46618.55	80550.21	14330.44	5227.76
2.0	29280.69	43222.05	72502.74	13320.23	-1809.50
2.5	25285.44	40163.29	65448.73	12408.09	-7951.37
3.0	21850.92	37403.89	59254.81	11583.01	-13320.21
3.5	18896.26	34910.23	53806.49	10835.34	-18020.87
4.0	16352.58	32652.78	49005.36	10156.61	-22143.27
4.5	14161.12	30605.60	44766.72	9539.35	-25764.64
5.0	12271.78	28745.87	41017.65	8977.00	-28951.36
5.5	10641.74	27053.48	37695.22	8463.76	-31760.55
6.0	9234.44	25510.68	34745.12	7994.52	-34241.41
6.5	8018.59	24101.82	32120.41	7564.75	-36436.36
7.0	6967.44	22813.03	29780.47	7170.46	-38382.01
7.5	6058.04	21632.05	27690.10	6808.09	-40110.01
8.0	5270.77	20548.01	25818.77	6474.49	-41647.73
8.5	4588.75	19551.25	24140.00	6166.86	-43018.87
9.0	3997.53	18633.19	22630.72	5882.70	-44243.99
9.5	3484.68	17786.21	21270.89	5619.79	-45340.91
10.0	3039.53	17003.50	20043.02	5376.15	-46325.14
10.5	2652.88	16278.99	18931.87	5150.01	-47210.15

PAGE TYPE 3

ALTERNATIVES FOR THIS GAME
BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30

NUMBER OF YEARS PER GAME 30

CRITICAL PRICES	12.00	15.00	99.00	0.	0.	0.	0.	0.	0.	0.
ALLOWABLE CUT	5	7	10	0	0	0	0	0	0	0
MINIMUM CUTTING AGE	130	130	120	0	0	0	0	0	0	0

ACRES IN WORKING CIRCLE	915
MINIMUM VALUES FOR INCLUSION IN TOTALS	
AGE, FOR GROWING STOCK	40
M BD. FT., FOR GROWING STOCK	1.5
CU. FT., FOR COMMERCIAL CUT	400
M BD. FT., FOR COMMERCIAL CUT	3.0
M BD. FT., FOR SALVAGE	1.5
ACRES PLANTED ANNUALLY	1
PERCENT OF ACRES LOST ANNUALLY	.040
M BD. FT. IN SHELTERWOOD	4.0
REGENERATION PERIOD	10.0
PSEUDORANDOM NUMBER GENERATOR	21.0
	2222.0

COSTS IN FIRST YEAR OF GAME	
PER ACRE (ANNUAL)	.20
PER 100 CU. FT. HARVESTED	.05
PER M BD. FT.	1.56
THIN ONE ACRE	25.00
PLANT ONE ACRE	30.00
CLEANUP OF ONE ACRE	25.00
RATE OF INCREASE IN COSTS	.01
RELATIVE VALUE OF INTERMEDIATE CUTS	
STUMPAGE PRICE, CU. FT.	1.00
STUMPAGE PRICE, BD. FT.	.85

PAGE TYPE 4

INITIAL DISTRIBUTION OF ACRES BY AGE
BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30
YEAR WITHIN GAME 0

	AGE(YEAR)										
AGE(DECADE)	0	1	2	3	4	5	6	7	8	9	TOTAL
0	12	7	7	7	7	7	7	7	7	7	75
1	7	7	7	7	7	7	7	7	7	7	70
2	7	7	7	7	7	7	7	7	7	7	70
3	7	7	7	7	7	7	7	7	7	7	70
4	7	7	7	7	7	7	7	7	7	7	70
5	7	7	7	7	7	7	7	7	7	7	70
6	7	7	7	7	7	7	7	7	7	7	70
7	7	7	7	7	7	7	7	7	7	7	70
8	7	7	7	7	7	7	7	7	7	7	70
9	7	7	7	7	7	7	7	7	7	7	70
10	7	7	7	7	7	7	7	7	7	7	70
11	7	7	7	7	7	7	7	7	7	7	70
12	7	7	7	7	7	7	7	7	7	7	70
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0

PAGE TYPE 4 (continued)

DISTRIBUTION OF ACRES BY AGE
BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30
YEAR WITHIN GAME 30

AGE(DECADE)	AGE(YEAR) 0	1	2	3	4	5	6	7	8	9	TOTAL
0	1	10	10	7	10	10	10	10	10	7	85
1	7	10	7	5	7	7	5	5	5	5	63
2	6	7	5	5	10	7	1	10	11	11	73
3	8	7	7	7	7	7	6	7	7	7	70
4	7	7	7	7	7	7	7	7	7	7	70
5	7	6	7	7	7	7	7	7	7	7	69
6	7	7	7	7	7	7	7	7	7	5	68
7	7	7	7	7	7	7	7	7	7	7	70
8	7	7	7	7	6	7	7	7	7	7	69
9	7	7	7	7	7	7	7	7	7	7	70
10	6	7	7	7	7	7	7	7	7	7	69
11	7	7	7	7	7	7	7	6	7	7	69
12	7	7	7	7	7	7	7	7	7	7	70
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0

PAGE TYPE 5

BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30

YEAR	ALLOWABLE CUT (1)	CUTTING AGE (2)	ACTUAL CUT CU.FT. (3)	ACTUAL CUT MBF (4)	CUMUL CUT CU.FT. (5)	CUMUL CUT MBF (6)	GRSTK VOL CU.FT. (7)	GRSTK VOL MBF (8)	TOTAL VOL CU.FT. (9)	TOTAL VOL MBF (10)
0	0	0	0	0	0	0	145108	4439	145108	4439
1	10	120	16135	129	16135	129	145108	4389	161243	4518
2	10	120	16135	128	32270	257	145108	4339	177378	4596
3	9	120	16135	126	48405	383	145108	4294	193513	4677
4	7	130	16135	0	64540	383	145108	4410	209648	4793
5	7	130	16135	78	80675	461	145108	4426	225783	4887
6	9	120	16135	129	96810	590	145108	4380	241918	4970
7	5	130	16135	65	112945	655	145108	4413	258053	5068
8	5	130	16135	65	129080	720	145108	4446	274188	5166
9	6	130	14719	78	143799	798	145108	4468	288907	5266
10	7	130	16135	92	159934	890	145108	4467	305042	5357
11	4	130	16135	103	176069	993	145108	4517	321177	5510
12	5	130	16135	116	192204	1109	145108	4551	337312	5660
13	5	130	16135	112	208339	1221	145108	4585	353447	5806
14	4	130	16135	54	224474	1275	145108	4636	369582	5911
15	7	130	16135	125	240609	1400	145108	4636	385717	6036
16	7	130	16135	140	256744	1540	145108	4635	401852	6175
17	4	130	16135	87	272879	1627	145108	4679	417987	6306
18	7	130	16135	120	289014	1747	145108	4678	434122	6425
19	10	120	16135	166	305149	1913	144424	4625	449573	6538
20	6	130	15450	121	320599	2034	144354	4638	464953	6672
21	7	130	16135	115	336734	2149	144284	4637	481018	6786
22	9	120	16135	160	352869	2309	144215	4588	497084	6897
23	10	120	15427	159	368296	2468	144145	4537	512441	7005
24	10	120	16135	153	384431	2621	144075	4484	528506	7105
25	9	120	16135	156	400566	2777	144006	4446	544572	7223
26	10	120	16135	166	416701	2943	143936	4393	560637	7336
27	7	130	16135	111	432836	3054	143866	4392	576702	7446
28	9	120	16135	155	448971	3209	143797	4353	592768	7562
29	10	120	15708	178	464679	3387	144154	4302	608833	7689
30	7	130	16135	43	480814	3430	144094	4401	624908	7831

BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30

YEAR	NON STK (11)	0-9 (12)	10-19 (13)	20-29 (14)	30-39 (15)	40-49 (16)	50-59 (17)	60-69 (18)	70-79 (19)	80-89 (20)	90-99 (21)	100-109 (22)	110-119 (23)	120-129 (24)	130-139 (25)	140-179 (26)
								AGE CLASSES								
0	5	75	70	70	70	70	70	70	70	70	70	70	70	70	0	0
1	4	78	70	70	70	70	70	70	70	70	70	70	70	67	0	0
2	3	81	70	70	70	70	70	70	70	70	70	70	70	64	0	0
3	3	84	70	70	70	70	70	70	70	70	70	69	70	62	0	0
4	2	77	70	70	70	70	70	70	70	70	70	69	70	69	0	0
5	1	76	70	70	70	70	70	70	70	70	70	69	70	70	0	0
6	1	79	70	70	70	70	70	70	70	70	70	68	70	68	0	0
7	0	77	70	70	70	70	70	70	70	70	70	68	70	70	0	0
8	0	75	70	70	70	70	70	70	70	70	70	68	70	70	2	0
9	1	75	70	70	69	70	70	70	70	70	70	70	68	70	3	0
10	0	74	71	70	69	70	70	70	70	70	70	70	68	70	3	0
11	1	67	75	70	69	70	70	70	70	70	70	70	68	70	6	0
12	0	61	79	70	69	70	70	70	70	70	70	70	68	70	8	0
13	0	56	82	70	69	70	70	70	70	70	70	70	68	70	10	0
14	1	60	76	69	69	70	70	70	70	70	70	70	68	70	13	0
15	0	60	76	69	69	70	70	70	70	70	70	70	68	70	13	0
16	0	57	79	69	69	70	70	70	70	70	70	70	68	70	13	0
17	1	57	77	69	69	70	70	70	70	69	70	70	68	70	16	0
18	0	59	75	69	69	70	70	70	70	69	70	70	68	70	16	0
19	0	62	75	69	70	69	70	70	70	69	70	70	70	68	13	0
20	1	63	73	70	70	69	70	70	69	70	69	70	70	68	14	0
21	0	65	67	74	70	69	70	70	69	70	69	70	70	68	14	0
22	1	70	61	78	70	69	70	70	69	70	69	69	70	68	12	0
23	0	75	56	81	70	69	70	70	69	70	69	70	69	68	9	0
24	0	80	60	76	69	69	70	70	69	70	69	70	69	68	6	0
25	1	83	60	76	69	69	70	69	69	70	69	70	69	68	4	0
26	0	86	57	79	69	69	70	69	70	69	69	70	69	68	1	0
27	0	88	57	77	69	69	70	69	70	69	69	70	69	68	1	0
28	1	91	59	75	69	69	70	68	70	69	69	70	69	67	0	0
29	0	91	62	75	69	70	69	68	70	69	69	70	69	64	0	0
30	0	85	63	73	70	70	69	68	70	69	70	69	69	70	0	0

BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGEO,THINNED AGE 30

YEAR	STUMPAGE PRICE 100 CU.FT. (27)	MBF (28)	STUMPAGE INCOME ANNUAL (29)	CUMULATED (30)	AREA COSTS ANNUAL (31)	CUMULATEO (32)	VOLUME COSTS ANNUAL (33)	CUMULATEO (34)
0	2.50	14.50	0	0	0	0	0	0
1	2.50	15.20	2363	2363	388	388	209	209
2	2.50	17.80	2682	5044	392	780	210	419
3	2.50	16.80	2489	7533	396	1176	209	628
4	2.50	13.40	403	7936	400	1575	8	636
5	2.50	14.10	1501	9438	404	1979	135	771
6	2.50	17.40	2614	12052	408	2387	220	991
7	2.50	11.80	1169	13221	412	2799	116	1107
8	2.50	11.10	1124	14345	384	3183	117	1224
9	2.50	12.20	1325	15670	361	3543	140	1364
10	2.50	12.90	1586	17256	424	3968	165	1530
11	2.50	10.10	1462	18718	395	4363	189	1719
12	2.50	8.30	1385	20103	433	4796	215	1933
13	2.50	9.00	1424	21527	403	5199	208	2141
14	2.50	10.90	991	22518	407	5607	105	2246
15	2.50	13.90	2151	24669	446	6053	235	2481
16	2.50	13.10	2255	26924	416	6468	265	2746
17	2.50	11.90	1439	28363	420	6888	171	2916
18	2.50	12.70	1945	30308	460	7348	234	3150
19	2.50	15.70	3024	33333	428	7776	321	3471
20	2.50	13.60	2039	35372	433	8208	239	3710
21	2.50	12.10	1802	37174	473	8682	230	3940
22	2.50	15.20	2815	39989	441	9123	319	4259
23	2.50	16.10	2962	42952	483	9606	320	4579
24	2.50	16.70	2970	45922	419	10025	311	4890
25	2.50	19.60	3484	49406	455	10479	322	5212
26	2.50	18.50	3499	52905	498	10977	345	5557
27	2.50	14.70	2049	54954	464	11440	236	5794
28	2.50	15.50	2821	57774	468	11909	330	6123
29	2.50	17.10	3470	61245	513	12421	381	6504
30	2.50	13.00	978	62223	511	12933	102	6606

PAGE TYPE 5 (continued)

BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30

YEAR	TOTAL COST ANNUAL (35)	TOTAL COST CUMULATED (36)	NET INCOME ANNUAL (37)	NET INCOME CUMULATED (38)	CURRENT VALUE GROWING STOCK (39)	TOTAL NET WORTH (40)
0	0	0	0	0	60992	60992
1	597	597	1765	1765	63417	65182
2	602	1199	2080	3845	73946	77792
3	604	1803	1885	5730	68856	74586
4	408	2211	-5	5725	55558	61283
5	539	2750	963	6688	58777	65465
6	628	3378	1986	8674	72580	81255
7	528	3905	641	9316	48313	57628
8	501	4406	623	9938	45464	55403
9	501	4908	824	10762	50507	61269
10	590	5497	997	11759	53551	65310
11	495	5993	441	12200	41389	53589
12	557	6550	396	12597	33399	45996
13	530	7079	473	13070	36751	49821
14	512	7592	479	13548	45848	59396
15	625	8216	1093	14641	59666	74307
16	596	8813	1046	15687	55867	71554
17	543	9356	587	16273	50660	66934
18	645	10001	970	17243	54307	71550
19	691	10692	1843	19086	67500	86586
20	603	11296	940	20026	57855	77882
21	664	11960	887	20913	50797	71710
22	710	12670	1710	22624	64429	87052
23	753	13423	1791	24415	67750	92165
24	689	14112	1934	26348	69601	95949
25	705	14817	2065	28413	81844	110258
26	770	15587	2056	30469	75995	106464
27	658	16245	1085	31554	59188	90742
28	724	16969	1533	33087	62090	95177
29	787	17756	1794	34881	68202	103083
30	549	18305	23	34904	51552	86456

PAGE TYPE 6

PRESENT WORTH AND RATE EARNED
BATCH TEST PROBLEM
TEST 1
GAME VARY CUT WITH PRICE
MANAGED,THINNED AGE 30
YEARS IN PERIOD 30

VALUE OF INITIAL GROWING STOCK--$ 60992.01

VALUES DISCOUNTED TO PRESENT (DOLLARS)

COMPOUND RATE (PERCENT)	FUTURE GROWING STOCK	ALL INCOMES	STOCK PLUS INCOMES	ALL COSTS	NET PRESENT WORTH
1.0	38247.39	52747.65	90995.04	15614.36	14388.67
1.5	32980.84	48739.60	81720.44	14470.52	6257.91
2.0	28460.19	45142.72	73602.91	13440.43	-829.53
2.5	24576.89	41909.46	66486.35	12511.14	-7016.80
3.0	21238.62	38998.17	60236.79	11671.31	-12426.53
3.5	18366.76	36372.40	54739.15	10910.99	-17163.85
4.0	15894.35	34000.11	49894.46	10221.45	-21319.00
4.5	13764.30	31853.20	45617.51	9595.00	-24969.50
5.0	11927.90	29906.94	41834.84	9024.86	-28182.04
5.5	10343.54	28139.54	38483.08	8505.07	-31014.00
6.0	8975.67	26531.81	35507.48	8030.34	-33514.87
6.5	7793.90	25066.81	32860.71	7596.04	-35727.34
7.0	6772.20	23729.57	30501.77	7198.01	-37688.26
7.5	5888.29	22506.84	28395.13	6832.62	-39429.50
8.0	5123.07	21386.90	26509.97	6496.61	-40978.65
8.5	4460.16	20359.34	24819.50	6187.10	-42359.61
9.0	3885.51	19414.93	23300.44	5901.53	-43593.10
9.5	3387.03	18545.45	21932.48	5637.60	-44697.13
10.0	2954.35	17743.61	20697.96	5393.28	-45687.33
10.5	2578.54	17002.89	19581.44	5166.75	-46577.33

PAGE TYPE 7

COMPARISON OF ALTERNATIVES
BATCH TEST PROBLEM
TEST 1
MANAGED,THINNED AGE 30
COLUMN 10

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	4530	4518	0	0	0	0	0	0	0	0
2	4621	4596	0	0	0	0	0	0	0	0
3	4716	4677	0	0	0	0	0	0	0	0
4	4807	4793	0	0	0	0	0	0	0	0
5	4897	4887	0	0	0	0	0	0	0	0
6	4992	4970	0	0	0	0	0	0	0	0
7	5083	5068	0	0	0	0	0	0	0	0
8	5173	5166	0	0	0	0	0	0	0	0
9	5273	5266	0	0	0	0	0	0	0	0
10	5364	5357	0	0	0	0	0	0	0	0
10	5364	5357	0	0	0	0	0	0	0	0
20	6632	6672	0	0	0	0	0	0	0	0
30	7893	7831	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0

COMPARISON OF ALTERNATIVES
BATCH TEST PROBLEM
TEST 1
MANAGED,THINNED AGE 30
COLUMN 40

YEAR	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	GAME 7	GAME 8	GAME 9	GAME 10
1	65346	65182	0	0	0	0	0	0	0	0
2	78294	77792	0	0	0	0	0	0	0	0
3	75197	74586	0	0	0	0	0	0	0	0
4	61083	61283	0	0	0	0	0	0	0	0
5	65246	65465	0	0	0	0	0	0	0	0
6	81284	81255	0	0	0	0	0	0	0	0
7	57210	57628	0	0	0	0	0	0	0	0
8	54890	55403	0	0	0	0	0	0	0	0
9	60757	61269	0	0	0	0	0	0	0	0
10	64798	65310	0	0	0	0	0	0	0	0
10	64798	65310	0	0	0	0	0	0	0	0
20	76305	77882	0	0	0	0	0	0	0	0
30	84641	86456	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0

Agriculture --- CSU, Ft. Collins

Myers, Clifford A.
1968. Simulating the management of even-aged timber stands.
U.S.D.A. Forest Service Research Paper RM-42,
32 pp. Rocky Mountain Forest and Range Experiment
Station, Fort Collins, Colorado 80521.

Presents a computer program, written in Fortran IV, for simulation of the management of even-aged timber stands. Changes computed include tree growth, harvest cuts, periodic thinnings, and catastrophic losses. Annual costs and returns are summarized in various statements of money value.

Key words: Simulation, ponderosa pine, timber management

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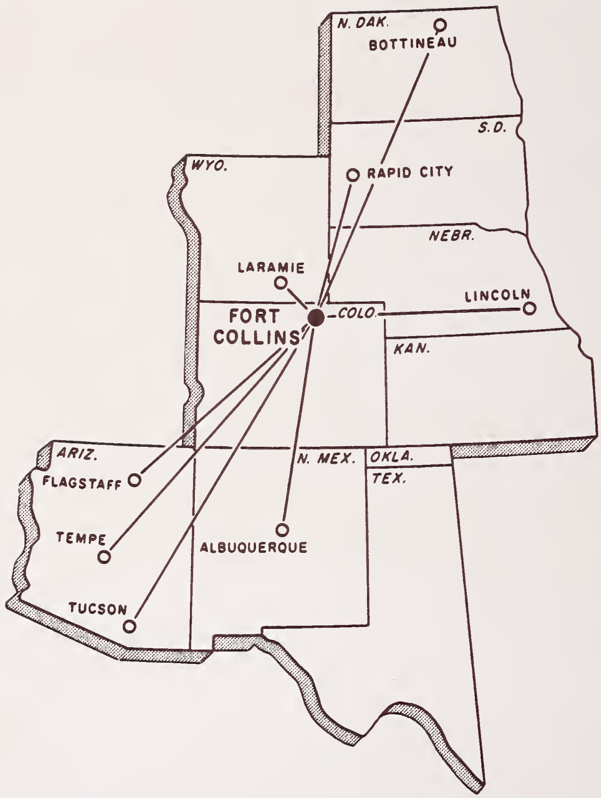
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